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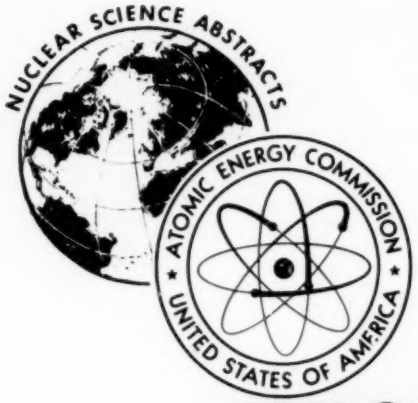

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Volume 18, Number 17, September 15, 1964

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Volume 18, Number 17 September 15, 1964

NUCLEAR SCIENCE ABSTRACTS

BIOLOGY AND MEDICINE

General

29164 (COO-119-229) RESEARCH IN RADIOBIOLOGY. Annual Report of Work in Progress on the Chronic Toxicity Program. Thomas F. Dougherty (Utah. Univ. Salt Lake City. Coll. of Medicine). Mar. 31, 1964. Contract AT(11-1)-119. 213p.

Separate abstracts were prepared for 12 sections of this report. (C.H.)

For abstracts of individual sections see: 29165, 29194, 29195, 29196, 29197, 29238, 29239, 29240, 29241, 29435, 29436, and 29975.

29165 (COO-119-229(p.111-26)) QUANTITATIVE STUDIES OF TRABECULAR BONE REMODELING. W. S. S. Jee, R. S. Mical, N. L. Dockum, R. Tegge, M. Lowe, and B. Burggraaf (Utah. Univ., Salt Lake City. Coll. of Medicine).

The variation in bone surface occupied by osteoid seams in lumbar vertebral bodies with age was characterized for 26 dogs. Of the 26 dogs, 20 were normal and 6 were partially or totally immobilized at the time of autopsy. The per cent of bone surface occupied by osteoid seams was used as an index of osteoblastic activity. This osteoblastic activity was found to be about 10% at the age of 600 days, dropping to a low of approximately 5% at the age of 2000 to 3000 days, and rising abruptly at age 3500 days to approximately 20% of the bone surface. The distribution of the osteoid seams was plotted to characterize the pattern of remodeling. Tentatively, it was found that the remodeling occurring was ranked in this order: first, the metaphysis; second, the diaphysis; and third, the epiphysis. Also, the frequency distribution of dorsal to ventral osteoid seams was 1.0, while the ratio of superior to inferior osteoid seams was 0.85. (auth)

29166 (ORNL-P-70) GENETIC AND FUNCTIONAL MOSAICISM IN THE MOUSE. Liane B. Russell (Oak Ridge National Lab., Tenn.). [1964]. Contract [W-7405-eng-26]. 37p. (CONF-613-1)

From the Symposium of the Society for the Study of Development and Growth, Amherst, Mass., June 1964.

Pathways that could lead to genetic mosaicism are reviewed. Data are summarized from a number of studies on both genetic and function mosaicism in the mouse with emphasis on mosaics that involve coat color characters. General questions of mutability, cell lineage, and gene action are discussed. (C.H.)

29167 (TID-20761) A CHEMICAL STUDY OF DNA FROM E. COLI K-12. Annual Progress Report. Robert L. Herrmann (Boston Univ. School of Medicine). [1963]. Contract AT(30-1)-3093. 15p.

Several strains of Escherichia coli K-12 that have the Lac marker at the point of origin in the conjugation process were isolated and characterized. Data are presented from studies on large-scale mating procedures to obtain adequate amounts of a specific gene sequence to carry out chemical and biological studies, with emphasis on proof of the validity of the conjugation approach; the fractionation of DNA isolated from the large-scale mating, and the characterization of DNA fragments. (C.H.)

29168 ADVANCES IN BIOLOGICAL AND MEDICAL PHYSICS. VOLUME 9. John H. Lawrence and John W. Gofman, eds. Advan. Biol. Med. Phys., 9: 1-496(1963). New York, Academic Press, 1963. $16.00.

A separate abstract was prepared for one article. One article was abstracted previously and appeared in NSA Vol. 17 as No. 37017. Other articles discuss the transcription of the genetic message, human chromosomal aberration, tissue transplantation, polarimetric analysis of protein structure, and analysis of biological similarity. (C.H.)

For an abstract of the individual paper see: 29169.

29169 ELECTRON PARAMAGNETIC RESONANCE STUDIES OF BIOLOGICAL INTEREST. Bernard Smaller (Argonne National Lab., Ill.). Advan. Biol. Med. Phys., 9: 225-69(1963). (TID-18839)

Applications of electron paramagnetic resonance (EPR) techniques in studies of biological interest are reviewed. It is pointed out that EPR findings indicate that for many biochemical reactions an intermediate species must be construed that is identified loosely as a complex. Applications of ERP techniques in studies of free radicals in irradiated molecules, enzyme reactions, photoinduced paramagnetic resonance signals in photosynthetic materials, and in triplet state studies are discussed. (C.H.)

29170 ISOTOPIC PLACENTOGRAPHY. AN EVALUATION OF ITS ACCURACY AND SAFETY. A. Weinberg, G. Shapiro, and D. F. Bruhn (Queens Gen. Hosp. Cent., Jamaica). Am. J. Obstet. Gynecol., 87: 203-9(1963).

The advantages of isotopic placentography include positive localization of the placental site with a high degree of accuracy, and without the risks of the digital examination. Conditions which may lead to error or difficulties in x-ray placentography such as prematurity, malpresentation,

hydramnios, multiple pregnancy, and pelvic tumors, are without influence. No operative procedures are necessary such as used in retrograde femoral arteriography. The whole-body and gonadal radiation to mother and fetus is minimal (1%) in comparison to that received in 2 film x-ray placentography. If a thyroid blocking agent is used, the absorbed dose delivered to the fetal thyroid will be well within the values as listed by the Federal Radiation Council and about 1% of the dose delivered by conventional radiographic techniques. However, because of the special sensitivity of the child's thyroid gland to the carcinogenic effects of radiation, an attempt to reduce the dosage by using other radioactive isotopes of iodine or by substituting radioactive chromium for radioactive ^{131}I is certainly indicated. Preliminary studies showed that pure gamma emitters ^{125}I and ^{51}Cr have special merit for isotopic placentography. Localization of the placental site in cases of suspected placenta previa is often of such obstetric importance that exposure of the fetus to some radiation danger is justified. Isotopic placentography is one way in which the danger may be reduced. A further reduction may be achieved by using the isotopes ^{132}I, ^{125}I, and ^{51}Cr, as the radioactive isotope in place of ^{24}Na or ^{131}I. (Excerpta Med., Sect. XXIII, 1: No. 2, (Feb. 1964)).

29171 THE APPLICATION OF RADIOISOTOPES TO THE STUDY OF CEREBRAL BLOOD FLOW USING EXTERNALLY PLACED DETECTORS. Philip C. Johnson, Jr. (Baylor Univ., Houston, Tex.). Angiology, 15: 75-81 (Feb. 1964).

Mathematical expressions are derived for using intravenously injected radioisotopes to estimate cerebral blood flow. The following expression (where I is the injected radioactivity, I_{Hd} is the activity of the head, A is the area of the time-concentration curve (for head and heart), and T is the duration of the time-concentration curve) was obtained: $(I_{Hd}/I) = (A^2_{Hd} \times T_{Ht}/T_{Hd} \times A^2_{Ht})$. Three different approaches to the estimation of cerebral flow or volume by using externally placed detectors are described. To estimate flow contained within intact vessels, requires a knowledge of the cross-sectional area and of the speed with which the flow is passing a given reference point. The velocity of flow in a large artery is too rapid to be estimated by the usual radioisotope instruments. However, flow in capillaries and veins is relatively slow allowing estimation of the flow speed with conventional ratemeter circuits. Each of the methods described is more concerned with capillary flow than arterial flow. An estimation of velocity of flow through the head was attempted by the Oldendorf method and by the formula of Sevelium and Johnson. The latter substitutes A/T for flow in the derived equation; flow velocity is inherent in the substitution and is represented by the transit time, T. There are basic differences in the transit time of the two formulas. The Oldendorf formula uses a transit time which is completed during the early phase of the time activity curve. The other formula uses more conventional transit time which includes the entire downslope extrapolated to the baseline. It remains to be proven which of the two is more correct. The problem of obtaining a phantom adequate for estimation of monitored cerebral volume is discussed. The problems of a thyroid phantom are similar to that encountered in the construction of a cerebral phantom. Before a phantom can be considered adequate for the task, a pulse height spectrum of radioactivity in the cerebral circulation should be compared to the spectrum from the phantom. The problem is simplified when the detector is adjusted to accept only primary γ-ray energies but this markedly decreases the counting rate which in turn increases the statistical error of the determination. At least for thyroid, the error without pulse height analysis and correct phantoms can affect the counting rates by a factor of two or more. It is likely that incorrect cerebral phantoms would produce similar changes. (BBB)

29172 AN UNUSUAL AUTOPSY SERVICE. D. Murray Angevine (Univ. of Wisconsin, Madison). Arch. Pathol., 76: 593-4(Dec. 1963).

Joint Japanese-United States studies, being made at the Atomic Bomb Casualty Commission (ABCC) in the cities of Hiroshima and Nagasaki on the late effects of atomic bombing, are described. With the cooperation of the National Institute of Health of the Japanese Welfare Ministry a general mortality investigation, known as the Life Span Study, is in progress on 100,000 persons (Hiroshima 75,000, Nagasaki 24,900) of whom 20,000 (Hiroshima 13,722, Nagasaki 6243) comprise what is known as the Adult Health Study Sample. The latter undergo a complete physical examination with lab studies every two years. In addition to clinical observations the study is based largely upon carefully performed autopsies. To obtain permission for autopsies on those who die, it has been necessary for ABCC to develop an elaborate program for cadaver procurement, the details of which are described. It is necessary to obtain permission for autopsy on an estimated 750 of a total 3200 deaths per year in Hiroshima and 240 of 2300 in Nagasaki. The procurement plan consists of; a daily information-gathering system to learn of recent deaths in a minimum of time; the careful screening of such information to select cases from the sample under study; and negotiations with families of the decreased to procure consent for autopsy. (BBB)

29173 THE LABELING OF HUMAN PLATELETS WITH RADIOCHROMATE. M. G. Davey and Harry Lander (Univ. of Adelaide, Australia). Australian J. Exptl. Biol. Med. Sci., 41: 581-93(Dec. 1963).

A modified technique for labeling human blood platelets with radioactive sodium chromate is described, and is compared with those previously in use. The uptake of radiochromate by platelets is greatest when the platelet suspension is of small volume, plasma protein is absent, and the sodium chromate concentration is 0.2 to 3.0 μg/10^{10} platelets. The rate of the reaction is not affected by its duration up to 40 min, but is enhanced by an increase in temperature. About one-third of platelets in suspensions labeled as described are viable, and survive in the circulation for 8–10 days. The procedure for labeling platelets from a 500-ml blood sample is as follows. The centrifuged platelets were not washed, but at once resuspended in 2 to 3 ml of 0.2% Triton WR-1339 solution in saline and radiochromate was added. When the donor's platelet count was normal, about 300 μC of ^{51}Cr (as Na_2CrO_4) was used, a larger amount being required when the platelet count was subnormal (<150,000/mm^3). The platelet suspension was allowed to stand for 30 min at room temperature. It was then centrifuged at 1200 g for 15 min, the supernatant replaced with 25 ml of the plasma/Triton/saline mixture, and centrifugation repeated. The labeled platelets were then resuspended in a further 30 ml of the plasma/Triton/saline mixture. Two ml of ascorbic acid solution (100 mg/ml) were added to ensure oxidation of free chromate, and the suspension was injected intravenously from a siliconed syringe. The procedure required 2 to 2½ hours for its completion. The labeled suspensions were infused as soon as possible after their preparation. (BBB)

29174 INFLUENCE OF THE ENVIRONMENT ON THE UNBORN. Ian W. Monie (Univ. of California, San Francisco). Calif. Med., 99: 323-7(Nov. 1963).

The teratogenic effects of various biological, chemical, and physical agents (viruses, hormones, nutritional deficiencies, drugs, ionizing radiations), especially with regard to the human embryo, are revised. (BBB)

29175 ISOTOPIC DISSECTION. NEW APPLICATION OF RADIOACTIVE ISOTOPES. J.-J. Bernier, A. Lambling, M. Cremer, and N. Vidon (Hôpital Bichat, Paris). Concours Med., 85: 7-29(Jan. 5, 1963). (In French)

Isotopic dissection uses radioisotopes to determine the volume of water and the quantities of Na and K in the organism; these values may be related to the weight of muscle, viscera, and fat in the patient. The method is a development of that of F. D. Moore. In particular the method of dilution is used to determine volumes limited by a membrane; illustration of the technique is for the plasma volume (by blue T, radioalbumin, macrodextran) and red corpuscles (by ^{51}Cr, ^{32}P, CO (carbon monoxide, not cobalt), and ^{59}Fe). Determination of H_2O, Cl, Na, and K, expression of results, and analysis of different tissues are discussed. In particular the method is applied to determination of exchangeable water, demonstrated with the necessary calculations. The analysis may also be based on exchangeable K or exchangeable Na, and sample comparisons are made. Application to patients with increased weight (cirrhosis) indicated no latent edema, no accumulation of fat, but loss of noble tissue. Two cases of severe loss of weight (cancer of the pancreas, severe diarrhea) are also studied; the water method and the Na-K method are not in complete agreement, but they fall within 20% in these studies. The method is of value in obtaining information in patients who have gained or lost weight which is of great prognostic value in metabolic or chronic illnesses. (BBB)

29176 INTERPRETATION OF RADIOACTIVE GAS CLEARANCE RATES IN THE LUNG. J. B. West, R. A. B. Holland, C. T. Dollery, and C. M. E. Matthews (Medical Research Council, Hammersmith Hospital, London). J. Appl. Physiol., 17: 14-20(Jan. 1962).

The use of gaseous mixtures labeled with ^{133}Xe, ^{15}O, and ^{11}C to measure respiratory function is discussed, with reference to both practical and theoretical aspects. The possible use and theoretical basis of a new technique employing $C^{15}O_2$ are explored. Clearance rates of this short-lived radioactive gas (^{15}O half life = 126 sec) from defined areas of the lung can be used to measure regional blood flow and gas exchange. The clearance rates are measured by external counting over the chest during a short period of breath holding following a rapid inspiration of the gas. Two processes are necessary for the clearance of any radioactive gas from the counting field, namely, transfer from alveolar gas to pulmonary capillary blood, and subsequent removal of the active gas from the field. Oxygen-15-labeled CO_2 is lost from alveolar gas exceedingly rapidly, and can therefore be used to separate these two clearance rate processes. Theoretical analysis shows how that can be done, and experiments designed to test the theory are described. Although considerable approximations are necessary, the analysis clarifies the factors controlling the clearance rate of any radioactive gas. One consequence is that the large variations in the regional uptake of radioactive CO and O_2 previously reported are probably overestimates. (BBB)

29177 ISOTOPIC AND FLUORESCENT STUDIES OF PROTEINS OF SKIN GRAFTS AND HOST. H. G. Kemp, G. E. Pierce, W. F. Seip, C. C. Burch, Jr., S. C. Morrel, M. T. Edgerton, Jr., and F. W. Barnes, Jr. (Johns Hopkins Univ., Baltimore and Hospital for Women of Maryland, Baltimore). J. Cellular Comp. Physiol., 63: 121-34(Apr. 1964).

Iso- and homologous skin grafts from mice previously given ^{35}S-L-methionine were placed on five recipient mice for 44 hours and label distribution in the proteins of the recipients was measured. The results suggest that two kinds of distribution can occur. In one of these, concentration of label in the various tissues was that expected from breakdown of protein in the graft, leading to freeing of constituent amino acids and dispersion of these to the host tissues. In the other, label distribution showed an unusual preference for certain tissues of the host, especially skin and brain. On the other hand when it was the recipient mice that were labeled, the iso- and homologous grafts were found over a 48-hour period to have achieved protein labeling equal to that of the proteins of the host's skin. This unexpected result is not satisfactorily explained by greater rate of incorporation of labeled amino acid in the intrinsic proteins of the graft. In 48-hour-old grafts, proteins of homografts 30 and 60 minutes after intravenous administration of ^{35}S-L-methionine were found enriched with isotope to a considerably greater extent than those of auto- or isografts (the latter falling between the other two). When isologous serum protein labeled with ^{35}S was injected into the host at 48 hours after grafting, the homograft proteins were again preferentially labeled. The isografts again showed intermediate results. Fluorescent rabbit antiserum made by injection of whole guinea pig serum, was found to remain attached to two- and five-day-old homografts of skin in guinea pigs. It was found throughout the collagen bundles of the dermis. Autografts and isografts did not show this. Epidermis effects are not yet entirely clear. It seems possible that certain globulins normally present in the host's serum infiltrate the homograft and perhaps are bound to some of its constituents, at least as early as two days after skin transplantation. The results were predicted from the discussed theoretical basis which led to the statement that normal tissue proteins circulating in the blood may be expected to interact and combine with complementarily different substances in various tissues to which they have access. The results agree also with the prediction that the graft receives various host proteins including those from skin, and under appropriate conditions sends some of its normal proteins to the corresponding tissue of the host. The experimental work thus lends support to the mechanism of graft rejection which is suggested and helps indirectly to support a new explanation of immunity. (auth)

29178 EVALUATION OF THE DIFFUSION-CHAMBER CULTURE TECHNIQUE FOR STUDY OF THE MORPHOLOGICAL AND FUNCTIONAL CHARACTERISTICS OF LYMPHOID CELLS DURING ANTIBODY PRODUCTION. Elmo E. Capalbo, Joseph F. Albright, and William E. Bennett (Oak Ridge National Lab., Tenn.). J. Immunol., 92: 243-51(Feb. 1964).

By a cytokinetic study of hemagglutinating antibody production it is shown that diffusion chambers constructed of 0.1-μ porosity filters and implanted into the peritoneal cavities of irradiated recipient mice are useful for quantitatively evaluating cultures of isologous spleen cells during antibody response. During the first three days of culture there is an 88% decrease in the total number of cells which can be recovered; thereafter, the number of cells remains constant for at least 12 days. The production of hemagglutinin follows the typical time-course of antibody production

by cells cultured freely in the peritoneal cavity of recipients. Synthesis of new antibody by cells cultured in chambers continues for at least 14 days and during the stationary phase of the response is presumably balanced by an equivalent rate of decay of existing antibody. During the over-all decline in total cell number during the first three days of cultures undergoing primary antibody response, certain types of cells undergo a relative increase. These are reticulum, blast, and plasma cells and phagocytes which are induced to selectively proliferate by antigen stimulation. Other types of cells, granulocytes and normoblasts, decrease disproportionately. (BBB)

29179 DETERMINATION OF ORGAN VOLUMES BY SCINTILLATION SCANNING. Richard P. Spencer (Yale Univ., New Haven). J. Nucl. Med., 5: 444-52(June 1964).

A method is described for estimating organ volumes on the basis of anteroposterior and lateral scintillation scans after the administration of γ emitting radioisotopes. The discussion is illustrated by the determination of the volume of the human bladder and the weight of the chinchilla kidney after administration of ^{203}Hg-chlormerodin. Potential uses of the techniques are pointed out. (auth)

29180 A GALLIUM^{68} POSITRON COW FOR MEDICAL USE. Yukio Yano and Hal O. Anger (Univ. of California, Berkeley). J. Nucl. Med., 5: 485-8(June 1964).

The ^{68}Ge–^{68}Ga positron cow is a convenient and economical source of ^{68}Ga-EDTA for use with the positron scintillation camera for brain tumor localization. Design features of the apparatus, ^{68}Ga collection, the preparation of ^{68}Ga-EDTA, and the separation of ^{68}Ga from EDTA solution for use in the preparation of other chemical forms are discussed. (C.H.)

29181 THE RAPID DETECTION OF COLIFORM MICRO-ORGANISMS BY A RADIOMETRIC METHOD. J. Pijck and A. Defalque (Université, de Grand, Belg.). J. Pharm. Belg., 18: 180-90(Mar.-Apr. 1963). (In French)

A radioisotope technique is described for detection of contamination of water by sewage by the $^{14}CO_2$ evolved from labeled Escherichia coli. (BBB)

29182 RADIOCHEMICAL METHOD FOR INVESTIGATION OF THE ENDOGENIC BREATHING OF BACTERIA SPORES. A. Gomes de Almeida (Universität, Vienna). Mikrochim. Ichoanal. Acta, No. 2-4, 516-38(1964). (In German)

A radiochemical method is described for determining the endogenic respiration of bacterial spores. A nutrient solution for the cultivation of radioactive bacteria was obtained by the assimilation of radioactive carbon dioxide with the aid of a green leaf and its extraction with water and acid. These bacteria were separated from the nutrient medium by means of isotonic sodium chloride solution and brought to the spore stage. The specific activity of the spores in the best experiments was 3×10^3 disintegrations per minute and milligram spores. About 30 mg of the spores were kept suspended in sodium chloride solution at a particular temperature for the respiration experiments. Subsequently, the radioactive carbon dioxide evolved during this incubation was driven out by means of a known amount of inactive carbon dioxide, absorbed in alkali, and finally precipitated with barium. The carbon dioxide liberated from the precipitate was measured in a gas counting tube. The radioactivity served as a measure of the respiration of the spore suspension. At room temperature the spore respiration was approximately three times higher than at 0°C, at 37°C about 9 times higher. The vegetative forms of Bacillus mesentericus respired 1.7% of their dry mass per hour. Assuming that this consists of 50% carbon and that the respiratory coefficient is equal to 1, this endogenic respiration corresponds to a Q_{O_2} value of 16. The endogenic respiration of the spores was 255 times smaller than that of the vegetative forms. This corresponds to a Q_{O_2} value of 0.06. The lowering of the respiration performance in the spore state was considered noteworthy from the standpoint of the metabolic economy. (auth)

29183 THE RADIOACTIVELY CONTAMINATED PATIENT UNDER COMBAT CONDITIONS. Charles E. Coner (Army Nuclear Medicine Research Detachment, New York). Military Med., 126: 424-31(June 1961).

The problem expected to occur when an Army medical installation located outside a fallout area is receiving patients from a fallout area and the question of how to monitor and decontaminate incoming patients and vehicles, are presented. (BBB)

29184 RADIO-BIOLOGICAL RESEARCH AT THE NATIONAL NAVAL MEDICAL CENTER. C. B. Galloway (Dept. of the Navy, Washington, D. C.). Military Med., 126: 665-7(Sept. 1961).

The general organization of the Research Program of the Medical Department of the Navy and specifically the Program in Radiobiological Research at the National Naval Medical Center (Bethesda) as it relates to the rapidly changing techniques are discussed. (BBB)

29185 DIGITAL OR ANALOG METHODS FOR RADIOISOTOPE MEASUREMENT? Bergene Kawin and Frank V. Huston (Veterans Administration Hospital, Fort Howard, Md.). Nucleonics, 22: No. 7, 86: 88-90; 92(July 1964).

The limitations and merits of analog and digital methods of count recording are discussed and illustrated using the results of simultaneous measurements by the two techniques. (D.C.W.)

29186 X-RAY SMALL-ANGLE SCATTERING WITH SUBSTANCES OF BIOLOGICAL INTEREST IN DILUTED SOLUTIONS. O. Kratky (Universität, Graz). Progr. Biophys. Mol. Biol., 13: 107-73(1963).

Theoretical aspects, instrumentation, and practical applications of this technique are reviewed with reference to 135 reports in the pertinent literature. The theory of the particle scattering of x rays is discussed, with particular reference to the Guinier approximation. The effect of collimation on the shape of the scattering curve is considered. According to the methods described the size and shape of the molecules can be determined. The experimental techniques and the production of the radiation and its registration are considered. Applications of the method for estimation of the size and shape of proteins (edestin, bovine serum albumin, γ-globulin, lysozyme, catalase), viruses, RNA, DNA, and polypeptides are discussed. (BBB)

29187 THE RADIOISOTOPE LABORATORY OF THE ISTITUTO DI RADIOLOGIA OF THE UNIVERSITÀ DI CAGLIARI. P. Ballicu and A. Congiu (Università, Cagliari, Italy). Rass. Med. Sarda, 65: 255-72(Mar.-Apr. 1963). (In Italian)

The laboratory for radioisotopes of the Università di Cagliari is described. The area contains an entrance, decontamination room, areas for high activity work, a radiochemical laboratory, a room for administration of high-energy doses and sampling, and a patient study room. Details are given in a floor plan. Details of the construction and surfacing of walls and floors, appliances, and heating are outlined and illustrated with drawings and photographs. The furnishings of the various rooms are

described; the decontamination room contains a monitor which sounds a signal when a certain activity level is surpassed in the room. The laboratory is equipped to handle ^{24}Na, ^{32}P, ^{42}K, ^{51}Cr, ^{59}Fe, ^{60}Co, ^{72}Ga, ^{82}Br, ^{131}I, and ^{198}Au—the usual B and γ emitters, and there is sufficient protection for the localization of neoplasmas, evaluation of physiologic function, and measurements of fluid exchange in the organism, for example, and more especially internal β radiotherapy with colloidal suspensions. The laboratory is self-contained and ancillary examinations and calculations may be made within it as well as experimental radiation studies. (BBB)

29188 TRANSISTOR CIRCUIT FOR ADAPTING A MULTICHANNEL ANALYZER TO NEUROPHYSIOLOGICAL WORK. O. Dayle Sittler (Texas A and M Univ., College Station) and Peter Tsao. Rev. Sci. Instr., 35: 872-4(July 1964).

A simple transistor circuit is described to adapt a commercial multichannel pulse-height analyzer, without altering its circuits, for neurophysiological studies. With this circuit, nerve impulses, or tape-recorded nerve impulses, can be sorted out according to their sizes by a multichannel analyzer. (auth)

29189 IRRADIATION OF SEED WITH RELATIVELY SMALL GAMMA-RAY SOURCES. W. R. McMurray and J. S. Vermaak (African National Physical Research Lab., Pretoria). S. African J. Agr. Sci., 6: 91-102(1963).

A simple rotating tank technique for the irradiation of seeds with ^{60}Co gamma radiation to produce genetic mutations is described. The dose rate to the seed for tanks of different size and seed content was determined experimentally. For a tank 10 cm diameter and 11 cm long the average dose rate is 880 roentgens/hour/curie when the tank is 50 per cent full of seed. The measured dose rates for different percentage seed contents are compared with calculated values assuming ideal geometry and mixing. An important discrepancy is noted for tank fillings exceeding 50 per cent. The measured values were confirmed by two independent methods which gave results in close agreement with each other. The distribution of dose received by different seeds irradiated simultaneously was shown to have a mean square deviation of less than ±5 per cent about the mean dose for irradiation times normally encountered. (auth)

29190 PAROXYSMAL NOCTURNAL HAEMOGLOBINURIA STUDIED WITH RADIOISOTOPES. H. Kummer. Schweiz. Med. Wochschr., 93: 1506-8(1963).

In 3 cases of paroxysmal nocturnal hemoglobinuria (PNH), the erythrocyte survival time was determined with the aid of ^{51}Cr. The curves showed the characteristic break which, according to other authors, indicates the existence of 2 red cell populations. Further investigations with ^{51}Cr and ^{59}Fe indicated that the erythrocyte survival time in PNH is influenced by injury to the red cells during the tagging process. In his cases the author found no significant second red cell population with short survival time which might account for the clinical and hematological symptoms. The hypothesis of a single red cell population is presented and discussed in the light of recent findings relating acetylcholinesterase activity in the red blood cells. In the light of a case of low red-cell glucose-6-phosphate dehydrogenase investigated in a similar manner, the author considers the pathophysiological relationship of the 2 conditions. (Excerpta Med., Sect. XXIII, 1: No. 3, (March 1964)).

29191 LABELING OF NATURAL PRODUCTS AS AN AID IN THE ESTABLISHMENT OF STRUCTURE: MOLECULAR WEIGHT DETERMINATION ON A MICROGRAM SCALE. Martin Wenzel and Paul-Eberhard Schulze (Freie Universität, Berlin). Z. Anal. Chem., 201: 349-58(1964). (In German)

Methods are described, and illustrative examples cited, whereby organic natural products whose constitution is still unknown can be tritium-labeled by exchange, or by biosynthesis in the presence of H_2O, $^{14}CO_2$, ^{35}S, and other labeled precursors, transformed on a μg scale, and the derivatives obtained qualitatively detected by means of their radiation emission. Moreover, treatment with a reagent labeled with another isotope leads to double-labeled derivatives from which the molecular wt of the natural product or its equivalent can be computed from the quotient of both activities (e.g., ^{3}H, ^{14}C) utilizing one-μg amounts or less. Uses of tritium-labeled organic natural products are discussed. Molecular weight determinations were made of the following doubly labeled compounds: testosterone-^{3}H-acetate-^{14}C, 1-methyl-Δ^{1}-androsten-17β-ol-one (from methylandrostenolone-^{3}H-acetate-^{14}C), and N-(acetyl-^{14}C)-leucine-^{3}H. The sensitivity of these methods depended mainly on the specific activity which could be attained by the labeling procedures. The techniques for labeling, qualitative detection of labeled derivatives, radiochromatography of the derivatives, and molecular weight estimation are described in detail. (BBB)

Ecology

29192 (TID-20781) THE INFLUENCE OF CONTACT TIME AND MINERAL TYPE ON THE EXTRACTABILITY AND AVAILABILITY TO PLANTS OF RADIOSTRONTIUM AND RADIOCALCIUM FROM SOILS. (Arizona. Agricultural Experiment Station, Tucson). [nd]. Contract AT(11-1)-947. 138p.

Strontium-89 and ^{45}Ca were used as tracers in a study of the influence of various factors on the availability of ^{90}Sr to plants. Five calcareous soils and one acid soil were used, and the influence of contact time and soil mineral type on the adsorption of Sr and Ca by barley and tomato plants was determined by a rootmat technique and analysis of dried plant materials at various time intervals. Data are presented on the properties and availability of Sr and Ca from each soil. Implications of the findings in estimations of the fallout ^{90}Sr content in human food chains are discussed. (C.H.)

Metabolism, Tissue Distribution, and Toxicology

Refer also to abstract 29906.

29193 (CONF-548-1) THYROID I^{131} IN NEVADA CATTLE: 1961-1963. Clifton Blincoe and V. R. Bohman (Nevada. Univ., Reno). [1964]. Contract AT(04-3)-509. 6p.

From the American Society of Animal Science, Annual Meeting of the Western Section, Bozeman, Mont., July 1964.

Thyroid ^{131}I concentrations were determined during 1961, 1962, and 1963 for representative animals from three herds of cattle maintained on typical Nevada ranges at three locations in the state. One herd was maintained on the Nevada Test Site. Data were collected concomitantly

on the thyroid ^{131}I content of slaughter cattle from the area. The concentration of ^{131}I in cattle thyroid glands decreased with distance from the test site when fallout ^{131}I originated at the site. The greatest concentration of ^{131}I in thyroid glands of cattle observed during the period was attributed to very high yield nuclear weapons tests in the USSR in late 1961. (C.H.)

29194 (COO-119-229(p.127-32)) QUANTITATIVE AUTORADIOGRAPHIC DOSE DETERMINATIONS OF Pu^{239} IN BONES. N. L. Dockum, R. S. Mical, R. Tegge, M. Lowe, C. W. Mays, and W. S. S. Jee (Utah. Univ., Salt Lake City. Coll. of Medicine).

Quantitative autoradiographic dose determinations of ^{239}Pu in dog bones revealed that the surface deposition of Pu is nonuniform and varies from bone to bone as well as from one anatomical site to another. Vertebral surface deposits of ^{239}Pu were higher than deposits found in other bones. Specific dose-rates to given areas were as high as 11 to 48 times greater than skeletal retention data. Mosaic trabeculae, consisting of viable and nonviable bone, appeared in the femoral epiphysis and metaphysis after 186 days in animals receiving 0.3 μC of ^{239}Pu/kg of animal weight. The 0.015 μC ^{239}Pu/kg of weight dose resulted in no gross histopathological changes at one year, but 10 yr post administration two cases of osteogenic sarcoma appeared. (auth)

29195 (COO-119-229(p.133-51)) DISTRIBUTION OF Ra^{226} BETWEEN BLOOD CELLS AND PLASMA. D. R. Atherton, F. W. Bruenger, D. S. Buster, B. J. Stover, and C. W. Mays (Utah. Univ., Salt Lake City. Coll. of Medicine).

The concentration of ^{226}Ra in dog blood cells, c_c, was determined by the dilution or washing method and was found to be significant with respect to the plasma concentration, c_p. At 5 days after intravenous injection the average for 6 beagles was $c_c/c_p = 0.205 \pm 0.021$. In a single human study, c_p decreased more rapidly than c_c so that c_c/c_p increased with time. At 0.28 day c_c/c_p = 0.1 and increased to 0.6 ± 0.1 at 8 days. The transfer of ^{226}Ra between cells and plasma is consistent with a diffusion process. (auth)

29196 (COO-119-229(p.170-85)) $Sr^{90} + Y^{90}$ BREMSSTRAHLUNG EFFICIENCIES IN MAMMALS OF VARIOUS SIZES. R. D. Lloyd, C. W. Mays, D. R. Atherton, and G. N. Taylor (Utah. Univ., Salt Lake City. Coll. of Medicine).

Measurements of total-body bremsstrahlung efficiency (x-ray photon output/μC relative to that in water) were made in the intact mouse, rat, rabbit, and dog sacrificed two weeks after the injection of $^{90}Sr + {}^{85}Sr$. Efficiencies were determined by a comparison of the bremsstrahlung output from $^{90}Sr + {}^{90}Y$ and the gamma emission of ^{85}Sr. Results were checked by a β assay of the ashed animals. Bremsstrahlung efficiencies averaged 1.10 in a 0.04-kg mouse, 1.14 in a 0.13-kg rat, 1.23 in a 2.6-kg rabbit, and 1.32 in an 8.5-kg beagle. Extrapolating to a 70-kg human, a relative bremsstrahlung efficiency of about 1.4 is predicted. (auth)

29197 (COO-119-229(p.199-205)) DETERMINATION OF LOCALIZED ALPHA-DOSE IN SOFT TISSUE NEAR RADIOACTIVE BONE. Charles W. Mays and Alden B. Tueller (Utah. Univ., Salt Lake City. Coll. of Medicine).

Alpha dose-rates were calculated for the soft tissues close to flat radioactive bone mineral containing ^{239}Pu, ^{228}Th or ^{226}Ra on its surface or throughout its volume. The dose-rates were evaluated at various distances from the contaminated bone. (auth)

29198 (LADC-5937) WHOLE-BODY RETENTION OF INTRAVENOUSLY ADMINISTERED ^{132}CESIUM BY MAN. C. R. Richmond, J. E. London, and J. E. Furchner (Los Alamos Scientific Lab., N. Mex.). [1963]. Contract [W-7405-eng-36]. 15p.

The whole-body retention of about 0.7 μC of low specific activity ^{132}Cs was followed in each of four normal young adults for about 45 days after a single intravenous administration. The data obtained from the nearly 4π steradian geometry liquid scintillation detector were processed and fitted by an electronic computer method. Only one exponential rate was necessary to describe the time-course of retention. The average effective half life of 6.07 days for the group corresponds to an average biological half life of 77.5 days for stable Cs, if one uses a physical half life of 6.59 days in the conversion. The derived biological half lives ranged from 48 to 123 days. These values are considerably shorter than those reported by others using longer-lived radionuclides of Cs. There were no apparent reasons for this discrepancy; however, the low specific activity of the ^{132}Cs tracer might possibly be involved. (auth)

29199 (TID-20768) FINAL SCIENTIFIC REPORT [ON STUDIES OF BIOSYNTHETIC SEQUENCES USING WILD-TYPE NEUROSPORA CRASSA]. James B. Ragland (Baylor Univ., Houston, Tex. Coll. of Medicine). May 15, 1964. Contract AT(40-1)-2684. 18p.

Progress is reported in studies on metabolism by wild-type Neurospora crassa and several mutant strains. Data are presented on the ability to activate sulfate in vitro and the ability to utilize ^{35}S-sulfate in vivo of mutant strains requiring either cysteine, methionine, or some presumed intermediate in their synthesis. The role of enzyme systems in sulfate metabolism is also discussed. (C.H.)

29200 (UCD-472-110) THE EFFECTS OF CONTINUED Sr^{90} INGESTION DURING THE GROWTH PERIOD OF THE BEAGLE AND ITS RELATION TO Ra^{226} TOXICITY. 7th Annual Progress Report. A. C. Andersen (California. Univ., Davis. School of Veterinary Medicine). July 1964. Contract AT(04-3)-472. 168p.

The effects of continual ingestion of ^{90}Sr during the growth period of the Beagle and its relation to ^{226}Ra toxicity was studied in a colony of dogs with an average weekly population of 285. A code method was developed to record all experimental or therapeutic treatments throughout the life span of each dog, microanalytical techniques were used to determine blood chemistry values for all dogs, radiographic skeletal surveys were made periodically, and estimations were made of the skeletal dose of ^{90}Sr in growing dogs. Data are presented on diurnal variations of ^{90}Sr, Ca, and P in the plasma of adult beagles after continual ingestion of ^{90}Sr; the urinary and fecal excretion of ^{90}Sr in dogs after continual feeding; ^{90}Sr content in the hair, bones, and teeth of dogs after continual feeding of ^{90}Sr; the ^{90}Sr bremsstrahlung output from ^{90}Sr burdened beagles; and the one-year retention of ^{90}Sr by Beagles after chronic ^{90}Sr feeding to 18 months of age. Data are also included from studies on the effects of storage time on the vitamin content of prepared dog foods and methods for the ion exchange removal of ^{90}Sr from biologic wastes. (C.H.)

29201 EXPERIMENTAL URANIUM (AUTUNITE) POISONING IN GUINEA-PIGS. G. Catellani (Università, Naples). Acta Med. Vet., 9: No. 1-2, 21-60(1963).

The author describes the anatomo-histopathological aspect of chronic intoxication of guinea-pigs by uranium mineral (autunite). The mineral, given in powder form in

the feed, appears more toxic in males, in which early lesions appear on the cells of the seminal line. In all organs severe nuclear alterations are to be noted. Research confirms the danger, at certain dosages, of natural radioelements commonly considered of low specific activity. (Excerpta Med., Sect. XXIII, 1: No. 3, (March 1964)).

29202 DEVELOPMENT OF THE RESPONSE IN RAT INCISOR DENTIN TO INJECTED STRONTIUM AND FLUORIDE. James A. Yaeger, Clin F. L. Hinrichsen, and Myron J. Cohen (Univ. of Illinois, Chicago). Am. J. Anat., 114: 255-72(Mar. 1964).

Response to both F and Sr are described and compared, using microradiography and histochemical methods; and a previous postulate, that hypomineralization results from an inhibition of predentin sulfation, is modified to account for the observations reported. Male Sprague-Dawley rats, ~50 days old, were injected subcutaneously with either 5 mg of NaF per 100 g body weight or 125 mg of $SrCl_2$ per 100 g of body weight, as 25% solutions. Animals were examined at intervals of one, two, four, 8, and 16 hr and one, two, three, four, five, and 7 days after injection. Some animals were also injected with tetracycline at the same time as the F or Sr injections, and others were labeled with ^{35}S-sulfate (5 $\mu C/g$) during the experimental period. Sections of maxillary incisors were radiographed or photographed in uv light and demineralized sections were stained or autoradiographs were prepared. Hypomineralized components were apparent at one day after the injection of F and two days after the injection of Sr. Histochemically detectable changes developed simultaneously with the radiographic changes. Observations were interpreted as indicating that Sr and F inhibit or reverse the matrix aggregation normally occurring at the dentin-predentin junction, thus inhibiting mineralization. Explanation of the mechanism of action of Sr and F in producing the responses in dentin must therefore await accumulation of biochemical evidence, particularly concerning the toxicology of stable Sr. (BBB)

29203 CONCENTRATION OF I^{131} IN THE TRACHEA OF RATS. M. Hoebel and L. Miksche (Universität, Heidelberg). Arzneimittel-Forsch., 13: 654-5(1963).

The uptake of ^{131}I in the trachea of rats was measured in vivo and in vitro. Indications were found that the concentration of ^{131}I varies in different sections of the trachea. (C.H.)

29204 EFFECT OF MAGNESIUM DEFICIENCY ON THE UPTAKE OF ^{28}Mg BY THE TISSUES IN MATURE RATS. A. C. Field and B. S. W. Smith (Moredon Inst., Edinburgh). Brit. J. Nutr., 18: 103-13(1964).

Rats were given a semisynthetic diet free of Mg or the same diet supplemented with Mg for 18 days. On the last day each rat was given an intraperitoneal injection containing 1 mg stable Mg and 0.15–0.25 μC ^{28}Mg. The concentration of ^{28}Mg in the plasma of the Mg-deficient rats showed a maximum at 0.33 hr after dosing then fell exponentially. Values for the controls were greater than for the deficient rats and they fell exponentially with time between dosing and killing. Changes in specific activity of plasma were similar to those for concentration of ^{28}Mg except that values for the controls were less than those for the deficient rats at all intervals after dosing. Corresponding tissues of the Mg-deficient and control rats, killed at the same interval after dosing, showed differences in uptake of ^{28}Mg. Of the tissues of Mg-deficient rats, kidney, heart, liver, and brain took up more, and the mandible took up less, than corresponding tissues of control rats. Specific activity of corresponding tissues from the two groups differed only in the values for liver, heart, kidney, and brain, which were higher in the deficient animals. Tissues from the same rat differed markedly in their concentration of ^{28}Mg and specific activity. Liver, heart, and kidney had relatively high values; brain an intermediate value; and muscle, femur, and mandible low values. The relative specific activity of kidney and heart were greater than one in both groups 2 hr after dosing. That of the liver was greater than one at 3 and 12 hr after injection in deficient and control groups respectively. There was little difference between the Mg-deficient and control rats in the size of the exchangeable pool (1–5%) of Mg in both femur and mandible, but the flux of Mg between plasma and bone and the rates of accretion were much greater for both bones from control than from deficient rats. Factors controlling the uptake of ^{28}Mg by tissue are discussed, and it is concluded that the greater uptake by the heart, kidney, liver, and brain in deficient rats could arise in ways other than by the replacement of Mg lost in deficiency. (BBB)

29205 RADIOACTIVITY IN MAN. Brit. Med. J., 2: 1285-6(Nov. 23, 1963).

The Agricultural Research Council Radiobiological Laboratory annual report (1962-63) of the levels of radioactivity, especially from fission products, in foodstuffs is discussed. The effects of atmospheric nuclear tests in the autumns of 1961 and 1962 are clearly observable; ^{131}I concentration in milk rose rapidly in September of each year to reach a high peak in November and fell again in the following January. The peak concentrations were between 150 and 200 pC/l in each year, but the 12-month average was never greater than one-fifth of the acceptable value, 130 pC/l. These factual data do not support recent newspaper reports that ^{131}I levels were at times so high that serious consideration was given to preventing infants having liquid milk. When expressed as levels of acceptable values, the average values for ^{90}Sr in 1962 were $\frac{1}{3}$ those for ^{131}I. Until now milk and milk products have been responsible for more than half of the total intake of ^{90}Sr, but in 1963 home-grown grain harvested in 1962 is being consumed as flour, and because of the preharvest fallout in that year will contribute about five times as much ^{90}Sr as the flour originating in 1961 and eaten in 1962. In 1963, therefore, flour will be a quantitatively important source of ^{90}Sr and comparable to milk, in which levels will be as high as in 1962 or somewhat higher. Special areas, (small tracts of country where special combinations of circumstances such as rainfall and characteristics of vegetation and of soil lead to unusually high concentrations of ^{90}Sr in foods and milk) where locally produced foods were intensively analyzed, showed ^{90}Sr values ~20% above the national level. Analyses of human bone for ^{90}Sr in the second half show that the results for individuals over the age of 1 yr are not different in 1962 from 1961. Over the age of 1 yr the values in the second half of 1962 are higher than in the first half of 1962 or the second half of 1961. This rise was expected from the increased concentration of ^{90}Sr in milk in the summer and autumn of 1962. Though bones in 1963 will show further and age-dependent increases in levels of ^{90}Sr, varying in degree according to the composition of the diet at each age, the present levels are still less than 5% of the permissible levels for a population as a whole even in the most heavily contaminated children. (BBB)

29206 THE TRANSFER OF PLUTONIUM-239 FROM THE DIET OF A COW TO ITS MILK. B. F. Sansom (Agri-

cultural Research Council Inst. for Research on Animal Diseases, Compton, Eng.). Brit. Vet. J., 120: 158-61 (Apr. 1964).

The possibility that ^{239}Pu might be dispersed over limited areas of the countryside by a nuclear explosion or reactor accident prompted this estimate of the extent to which this nuclide is transferred from the diet of a cow to its milk, since no previous work on this subject was reported. The most probable form in which Pu would occur is as the finely divided oxide, of extremely low solubility. The amount of Pu in this form transferred to milk was expected to be extremely small and possibly difficult to detect, so the transfer of soluble Pu (as $^{239}PuCl_4$) from diet to milk was also investigated. Thus, a solution containing 48 mg $^{239}Pu^{4+}$ or 74.8 mg Pu as PuO_2 (of particle size <3μ) was administered orally to two mature lactating Ayrshire × Redpoll cows. The radioactivity found in milk, feces, and urine samples from both experiments was compared with a standard prepared directly from a known sample of the $PuCl_4$. The concentrations of Pu found in the milk samples from the two cows, expressed as a percentage of the dose per liter, are shown. Maximum milk concentrations of Pu were reached on the 2nd and 4th day (1.63 and 2.44% dose/l × 10^6) respectively after feeding $PuCl_4$ and PuO_2. The concentration of Pu in urine was about 1000 times that in milk, and the total excretion in seven days was ~0.2% of the dose in both cows. Within the limits of accuracy of the simple counting method used for feces samples, essentially all of the Pu administered in both experiments was recovered in the feces. Previous studies showed the absorption of $Pu(NO_3)_4$ from the gastrointestinal tract of rats to be only about 3×10^{-3}%, and the apparent excretion of ^{239}Pu in the urine in the present experiment does not indicate a higher absorption of Pu from the gut in the cow. It is suggested that most of the Pu found in the urine was derived from fecal contamination. The observed Pu levels in milk also may have been due to fecal contamination; the change of concentration with time did not show a consistent trend in either experiment, and there was no great difference in the Pu concentrations in the milk from the two experiments. In these experiments it is only necessary to assume the presence of less than 1 mg of feces/l to account for the whole of the Pu present in milk; however, from the point of view of the possible hazard to man, the actual source of the Pu is of little importance. The milking technique used in these experiments was probably at least as good as that used in commercial dairy herds, so that the concentration of Pu found can be taken as an indication of the minimum concentration occurring in milk after the ingestion by a cow of Pu in any form. The highest level recorded was about 1000 times less than the maximum permissible concentration in water recommended for occupational exposure by the International Commission on Radiological Protection. (BBB)

29207 CHEMICAL DISSOLUTION AND IN VITRO RECONSTRUCTION OF SPONGE CELL ADHESIONS. I. ISOLATION AND FUNCTIONAL DEMONSTRATION OF THE COMPONENTS INVOLVED. Tom Humphreys (Massachusetts Inst. of Tech., Cambridge). Develop. Biol., 8: 27-47(Aug. 1963).

The mechanism of cell adhesion was studied using aggregation of dissociated sponge cells as the experimental system. A method of chemical dissociation was developed for marine sponges using cold Ca- and Mg-free sea water. The viable, single cells resulting from this dissociation were able to aggregate and develop into functional sponges. Rotation-mediated aggregation was used to study various aspects of the aggregation of sponge cells. Four species of monaxonic sponges, Microciona prolifera, Haliclona occulata, Halichondria panicea, and Cliona celata, were utilized. The specificity of this divalent cationic requirement was tested by using modifications of sea water in which the divalent cationic salts were replaced by combinations of Ca, Mg, or Sr chloride. Normal aggregates formed when the divalent cations of sea water were substituted with: $CaCl_2$ alone, equimolar quantities of $CaCl_2$ and $MgCl_2$; or equimolar quantities of $CaCl_2$ and $SrCl_2$. When $MgCl_2$ or equimolar quantities of $MgCl_2$ and $SrCl_2$ were substituted, compact aggregates about one-half normal size were formed. Only very small, loose cell clusters formed with Sr^{++} alone. Other multivalent ions were not tested because normal aggregation can occur without them and because these results establish a preferential requirement for Ca. The results indicate clearly that both Ca and Mg have functions in cell aggregation which cannot be fulfilled by Sr or by each other. It is possible that Mg is required for cell migration and Ca for cell adhesion, but in these experiments the small aggregates formed in the presence of Mg alone appeared to be as firmly cohesive as normal aggregates. Low temperature was found to inhibit adhesion of chemically dissociated cells even when the divalent cations were added back to the cells. Mechanically dissociated cells aggregated rapidly at low temperatures. This difference was shown to be due to a factor released into the supernatant during chemical dissociation of sponge tissue. When this factor was added back to the chemically dissociated cells along with divalent cations, they adhered rapidly at low temperatures. This factor was species specific, causing adhesion only of cells from the same species. These results were interpreted to indicate that the sponge cell adhesion is composed of three basic components: the cell surface, divalent cations, and an intercellular material. Implications of these results for models of cell adhesion are discussed. (BBB)

29208 RADIONUCLIDES FOUND IN LIVERS OF TUNAS FROM THE PACIFIC IN 1958. Kakuma Nagasawa, Yasumas Kodo, and Yoshihiko Kashida (National Inst. of Hygienic Sciences, Tokyo). Eisei Shikensho Hokoku, 79: 235-6(Sept. 1961).

The livers of tuna and swordfish caught in the Pacific Ocean in 1958 were examined for radiocontamination. Among these, the ash from four samples which were markedly radioactive, were analyzed according to the Tompkins' method. The samples were separated by chromatography on Amberlite IR-120 into six fractions: 0.2N HCl effluent (Fr.1); 0.5% oxalic acid effluent (Fr.2); 5% ammonium citrate (pH 3.5) effluent (Fr.3); 5% ammonium citrate (pH 5.0) effluent (Fr.4); 3N HCl effluent (Fr.5); and resin ash (Fr.6). Iron-59 and ^{65}Zn were found in Fr.2 and Fr.3, respectively, while ^{90}Sr and ^{115m}Cd were found in Fr.4; ^{59}Fe and ^{65}Zn were separated by the fuming nitric acid precipitation method. The ^{90}Sr and ^{115m}Cd in the mother liquor of the nitric acid were separated and the ^{115m}Cd converted to cadmium sulfide and radiochemically analyzed. In two samples the concentrations (in μC/10 g fresh wt of liver) were: ^{59}Fe, 5.01×10^{-3}; ^{65}Zn, 5.66×10^{-2}; ^{90}Sr and ^{90}Y, 2.63×10^{-6}; and ^{115m}Cd, 1.23×10^{-2}. The highest gross activity of an ashed liver sample, obtained in September 1958 in the fishing area N 38° −E 154° to N 37° −E 153°, was 30,508 cpm/96 g (fresh wt) sample (analyzed four months after the fish was caught). (BBB)

29209 CHEMISTRY OF LIVER INJURY DUE TO PLUTONIUM-239. N. I. Elkina and Z. B. Tokarskaya.

Federation Proc., Transl. Suppl., 23: T533-5(May-June 1964). (Translated from Vopr. Med. Khim., 9: 154(1963)).

After intravenous injection of plutonium nitrate into rabbits in a dose of 7 μc/kg and into dogs in a dose of 2 μc/kg, a gradual progressive decrease in the total serum protein of the rabbits and dogs was observed, due mainly to a decrease in the albumin. A gradual increase in the serum aminopherase activity was observed, more marked in the glutamico-alanine than in the glutamico-asparagine enzyme. Urea synthesis was appreciably lowered in dogs during the period of development of frank cirrhosis of the liver. The serum alkaline phosphatase activity was increased only in the presence of frank cirrhosis and jaundice. The decrease in albumin and the increase in aminopherase activity were preceded by morphological disturbances. (auth)

29210 PLUTONIUM INHALATION STUDIES. VI. PATHOLOGIC EFFECTS OF INHALED PLUTONIUM PARTICLES IN DOGS. W. J. Clarke and W. J. Bair (General Electric Co., Richland, Wash.). Health Phys., 10: 391-8(June 1964). (HW-SA-3079)

The inhalation of $^{239}PuO_2$ particles administered in an aerosol to beagle dogs caused spontaneous deaths in animals having a lung burden of from 2 to 27 μc. Deaths occurred 55 to 855 days post-exposure and were preceded by a progressive lymphopenia and respiratory distress. Deposition of the particles in the lungs was followed by substantial translocation to the bronchial and mediastinal lymph nodes. The pathologic effects observed in the lungs of these animals consisted primarily of severe fibrosis followed by alveolar cell, bronchiolar, and squamous types of metaplasia. In the bronchial and mediastinal lymph nodes, with increasing particle deposition and fibrosis with time, the germinal centers were gradually replaced by fibrous connective tissue and reticulum cells. Although primary lung carcinoma was not found in the radiation damaged lungs of this continuing investigation, the blockage of lymphatic channels by scar tissue, together with the trapping of radioactive particles within the areas of severe parenchymal fibrosis, could possibly prove to be a potent source of carcinogenicity with time. (auth)

29211 OBSERVED EFFECTS OF PLUTONIUM IN WOUNDS OVER A LONG PERIOD OF TIME. S. E. Hammond and E. A. Putzier (Dow Chemical Co., Golden, Colo.). Health Phys., 10: 399-406(June 1964).

Measurable amounts of plutonium remaining in contaminated wounds have been counted periodically by gamma spectroscopy techniques to study the behavior over long periods of time. Eleven such cases and the resultant excretion of plutonium in the urine are discussed. These have been selected from over 100 exposures following during the past 6 years. The study has been divided into three arbitrary classes: Cases where plutonium at the site remains constant during the time of study, cases where measurable plutonium decreases to background after remaining constant over a long period and cases where the amount remaining steadily decreases following the accident. Plutonium excretion may be significant or negligible in each of these categories. Possible differences in conditions which might account for this are discussed. The study shows that no specific excretion pattern can be predicted from wound data. Histories of four cases in which the plutonium became encapsulated, forming nodules at the wound site, are included. (auth)

29212 UPTAKE OF OXYGEN-15-LABELED CO_2 COMPARED WITH CARBON-11-LABELED CO_2 IN THE LUNG. J. B. West and C. T. Dollery (Hammersmith Hospital, London). J. Appl. Physiol., 17: 9-13(Jan. 1962).

A method is described in which ^{15}O-labeled CO_2 is used to measure regional blood flow in the lung. A study of the factors controlling the clearance rate of radioactive CO_2 showed that ^{15}O-labeled CO_2 exhibited different physiologic behavior from ^{11}C-labeled CO_2. Hence measurements to clarify this apparent paradox and to help interpret the clearance rates of other radioactive gases in the lung were made. (BBB)

29213 THE EFFECT OF HIGH CONCENTRATIONS OF HEAVY WATER ON ROOT MORPHOGENESIS IN ZEA MAYS. Otto L. Stein and Gabriele M. Forrester (Montana State Univ., Missoula). J. Exptl. Botany, 15: 146-59(Feb. 1964).

A study was conducted to determine the effects of D_2O on organogenesis of the corn root and to correlate the changes with cytologic events. Submersion for 24 hr in solutions of 80 to 90% D_2O temporarily stopped growth of the primary root. During the treatment period the root-tip regions swelled as the result of radial cell enlargement primarily in the cortical region. Upon removal from D_2O, growth resumed, initially at a slower rate than controls but ultimately at similar maximum rates. Lateral root production was inhibited in that portion of the primary root which is the region of elongation at time of treatment. However, in the swollen region, lateral root formation was accentuated. The mitotic index dropped sharply upon introduction of the primary roots to 80% D_2O, but returned to normal by 24 hrs. At lower D_2O concentration (40%) the mitotic index returned to normal in 12 hr. Some of these results are similar to those found in wheat, but in wheat the initial rates during recovery did not equal those of the controls. In contrast, in corn roots this lag was only temporary and ultimately maximal rates similar to those of the controls were achieved. Swellings of the root tips as observed in corn apparently do not occur in wheat. The observed cell enlargement as well as increased root production at these locations indicates an auxin involvement, especially since in the previously produced region of the primary root, laterals are inhibited. The results indicate that the pericycle of the corn root is much more sensitive than the apical meristem. In the latter, recovery occurred readily, whereas at the same external concentration of D_2O the former did not produce lateral roots. This differential response may be a function of cell number (many cells in the meristem vs relatively few potential initials in the pericycle), or possibly involve the function of the quiescent region of the apical meristem. It is concluded that as a general and relatively gentle temporary inhibitor, heavy water is a useful tool for study of changes in rates of processes or changes in the geometry of a system. (BBB)

29214 A NORMAL REFERENCE STANDARD FOR RADIOCALCIUM TURNOVER AND EXCRETION IN HUMANS. Robert P. Heaney, Goran C. H. Bauer, Felix Bronner, John-Fredrik Dymling, Frederic W. Lafferty, B. E. C. Nordin, and Clayton Rich. J. Lab. Clin. Med., 64: 21-8(July 1964).

To overcome a lack of normal reference values for radiocalcium behavior in adult humans, a composite standard has been assembled from 23 studies performed in six laboratories. Both plasma Ca specific activity and isotope excretion values are presented at intervals from five to 300 hr after ^{45}Ca injection. The statistical grouping of plasma specific activity values at each time interval was relatively tight; the coefficient of variation approximated 20%. A small correlation with body surface area was detected, and sample variances were somewhat smaller when the individual values were corrected for differences

in area. No correlation between specific activity and either age or sex was observed. The data are presented solely to provide a preliminary numerical estimate of the normal range, and to offer a standard composite curve suitable for analysis by any of the several mathematical models describing Ca turnover. (auth)

29215 SECRETION AND EXCRETION OF CALCIUM BY THE HUMAN GASTROINTESTINAL TRACT. Robert P. Heaney and Thomas G. Skillman (Creighton Univ., Omaha and Creighton-Memorial St. Joseph's Hospital, Omaha). J. Lab. Clin. Med., 64: 29-41(July 1964).

Fecal excretion of Ca of endogenous origin was measured in 52 studies in 33 adult human subjects, under full metabolic balance conditions. Endogenous fecal Ca averaged 0.130 ± 0.047 g/day, was positively correlated with both fecal Ca and dietary Ca and was inversely correlated with fractional Ca absorption. The regression line relating endogenous fecal Ca with fractional absorption allowed estimates for total intestinal Ca secretion at both zero and 100% absorption; from these estimates it was calculated that approximately 15% of the total intestinal Ca secretion was nonabsorbable even under conditions when dietary Ca was completely absorbed (presumably because it enters the gut caudad of the absorption sites). Total intestinal Ca secretion, calculated so as to allow for this nonabsorbable fraction, averaged 0.194 ± 0.073 g/day, and could not be correlated with age, sex, dietary Ca intake, caloric intake, urine Ca, or plasma Ca. A weak correlation with body size (weight, surface area) was observed. The conditions studied were principally disorders of bone, Ca, and parathyroid metabolism, and in most of them total intestinal Ca secretion appeared identical. The sole exception was seen in two studies on a patient with acromegaly, in which total intestinal Ca secretion was over twice the mean value for the remainder of the group. (auth)

29216 THE UPTAKE OF RADIOACTIVITY BY FISH AND SHELLFISH. I. ^{134}CESIUM BY WHOLE ANIMALS. F. Morgan (Radiobiological Lab., Lowestoft, Eng.). J. Marine Biol. Assoc. U. K., 44: 259-71(1964).

Lab experiments were conducted in correlation with earlier studies of the radiocontamination of marine animal life by radioactive wastes discharged by the Windscale Factory into the coastal waters of the North Irish Sea. Experimental animals were kept at 10°C in tanks of sea water, or fresh water, to which ^{134}Cs was added, at a range of concentrations of ^{134}Cs varying from 1 to 16×10^{-3} μC/ml of water. For comparison, it is noted that the maximum permissible concentration in drinking water for occupational workers is 3×10^{-4} μC/ml. Typical results from whole animal uptake experiments, employing a wide variety of species (36) and lasting several months, are shown comparing uptake of marine fish, marine shellfish, and some freshwater species. The concentrations reached in each species after an exposure of 28 days are tabulated, as are the times required to reach the same concentration as the water. An overall range of two orders of magnitude was observed. The conspicuous features of these results are, first, the short times required by marine pelagic species, and most shellfish, except scallops and freshwater mussels, to reach water concentration, namely 0.5 to 4 days; secondly, the median times required by marine demersal species and bottom feeding species, and seawater eels, 6 to 17 days; and thirdly, the much greater times required by freshwater fish (including eels) and rays, 30 to 120 days. Comparing the two limiting groups with the median group of marine bottom-living fish, significant increase in speed of uptake is associated with the invertebrates, and with the energetic pelagic species; a significant decrease in speed of uptake is associated with patterns of osmotic regulation that do not involve swallowing. More detailed studies were conducted on the selected species plaice, lobster, and eel, species of interest in the Windscale, Winfrith, and Severn areas, of marine radiocontamination respectively. (BBB)

29217 INFLUENCE OF VARIOUS DRUGS ON THE TRANSPORT OF ^{131}I AND PAH ACROSS THE CEREBROSPINAL-FLUID-BLOOD BARRIER. H. Davson and M. Pollay (Univ. of London). J. Physiol. (London), 167: 239-46 (July 1963).

With the ventriculo-cisternal perfusion technique in the rabbit, the transport systems operative in the transport of p-aminohippurate (PAH) and ^{131}I across the cerebrospinal fluid (CSF)-flood barrier were studied in regard to modification of this process under various experimental conditions. Various drugs were added to the basic perfusion solution, and alteration in absorption was reflected by changes in the ^{131}I and PAH transfer constants. The loss of inulin in the outflow from the ventricular system served as the basis for calculating the rate of secretion CSF, which in this study was 9.6 μl/min, corresponding to a turnover rate of ~ 0.5%/min. Acetazolamide and dinitrophenol (DNP) reduced the secretory rate by ~ 50%. In addition, DNP inhibited the active transport of ^{131}I and PAH; in the case of PAH the inhibition was reversed by acetate. The inhibition of ^{131}I transport by ouabain and p-chloromercuribenzoate was demonstrated and presumed to be due to interference with certain enzyme systems. Evidence is also presented suggesting that the choroid plexus, like the kidney tubule, synthesizes certain acyl glycines which influence the active transport of ^{131}I and PAH out of the CSF. A similar situation exists in the kidney tubules of man, dog, and rabbit, where tubular secretion of PAH was increased 30 to 100% by acetate and its precursors, and depressed 60% by fatty acids of C_3 to C_{12} chain length and certain amino acids. (BBB)

29218 SYSTEMIC ABSORPTION OF RADIOACTIVE SODIUM IN FRESH AND HEALING TRAUMATIC WOUNDS. Wasyl W. Salak, Charles C. Wolferth, Jr., and John M. Howard (Hahnemann Medical Coll., Philadelphia). J. Trauma, 3: 453-9(Sept. 1963).

Model experiments were conducted with ^{22}Na to evaluate the ability of fallout radionuclides to penetrate injured skin. Injuries were produced in rats by traumatizing the tail on both sides with a sharp unsterile razor blade, the injury extending through skin and subcutaneous tissues to the periosteum. Wounds were left open, and the tails were continuously immersed in solution of ^{22}NaCl for two to 12 hr. An insignificant amount of ^{22}Na is absorbed through the intact skin of the rat's tail. The largest absorption was observed in 1-day-old wounds. Fresh wounds, when exposed immediately to radioactive solution, absorbed 57% less ^{22}Na than such wounds 24 hr later. The amount of ^{22}Na absorbed was directly proportional to the duration of exposure, temperature, concentration of radioisotope, and wound area. Granulating wounds presented a barrier that permitted relatively lower quantities of ^{22}Na to pass through into the systemic circulation. The rate of absorption per cm^2 of wound area per hr was relatively constant at any given stage of healing, regardless of whether the wound was exposed for two or 12 hr. The absorption of ^{22}Na from polyethylene glycol ointment was about 30% lower than from aqueous solution. It is suggested that the decreased absorption in fresh wounds was probably due to active bleeding and to reflex vasoconstriction; similarly,

extensive absorption found at 24 hr after injury could be explained on the basis of an inflammatory process with its increased blood flow, since ^{22}Na is mainly transported in blood. It would be of importance, therefore, to remove wound contaminants within the first day to prevent large absorption and systematic spread. (BBB)

29219 EFFECT OF GIVING PHOSPHATE SUPPLEMENTS TO BREAST-FED BABIES ON ABSORPTION AND EXCRETION OF CALCIUM, STRONTIUM, MAGNESIUM, AND PHOSPHORUS. Elsie M. Widdowson, R. A. McCance, G. E. Harrison, and Alice Sutton (Cambridge Univ., Eng.). Lancet, 2: 1250-1(Dec. 14, 1963).

Breast-fed baby boys were given a supplement of 120 mg P daily, as the neutral Na and K phosphates, on the 5th, 6th, 7th, and 8th days after birth; 11 other babies were not given the supplement. The intakes and the excretions of Sr, Ca, Mg, and P were measured on the 6th, 7th, and 8th days. Phosphate promoted, rather than hindered, the absorption of Ca and Mg, but the urinary excretion of Sr, Ca, and Mg was reduced. The excretion of traces of meconium may have accounted partly for the seemingly high fecal excretion of Sr, but there was no reason why the babies receiving phosphate would pass more or less meconium than those not receiving phosphate. The results for Ca would not have been affected by traces of meconium. The results support the explanation that the amount of P in breast milk may limit both the calcification of bone and the growth of soft tissue at this age. (BBB)

29220 STUDIES ON THE RADIOACTIVE CONTAMINATION OF FOOD. József Kovács (Fővárosi Vegyészeti és Élemiszervizsgálo Intézet, Budapest). Nepegeszsegugy, 43: 113-15(Apr. 1962). (In Hungarian)

Studies were made on the amount of ^{90}Sr and ^{137}Cs present in milk, spinach, lettuce, and sorrel. Spot checks were also made on grains, fruit, and imported fish. The natural and artificial contamination in various parts of Hungary was considered. Food contamination with radionuclides in Hungary is smaller than that shown by published worldwide figures. The greatest radioactivity was found in various shipments of imported fish which came from Morocco, Yugoslavia, and Norway and showed contamination of 120-160 $\mu\mu C$/100 g. (BBB)

29221 THE UPTAKE OF Cs^{137} BY CHLORELLA VULGARIS. C. M. Avio and L. Lenzerini. Pubbl. Staz. Zool. Napoli, 33: No. 2, 69-82(1963).

Cesium uptake by Chlorella vulgaris was determined to be a direct function of the number of cells and Cs concentration in the medium up to saturation limits. Cesium-137 concentrations above 100 μg/ml of Cs inhibited the growth of Chlorella. (C.H.)

29222 THE EFFECT OF ULTRAVIOLET IRRADIATION ON MITOCHONDRIAL PHOSPHORYLATION, INORGANIC PHOSPHATE-ATP EXCHANGE AND ATPASE ACTIVITIES. R. Duncan Dallam and James W. Hamilton (Univ. of Louisville, Ky.). Radiation Res., 22: 548-55(July 1964).

Results are presented which show that uv irradiation of mitochondrial suspensions results in the inhibition of phosphorylation associated with the oxidation of BOHB, the P_i–ATP exchange reaction, and the activity of ATPase stimulated by DNP and by $MgCl_2$. In the absence of stimulants, ATPase is activated by uv irradiation, and both the inhibitory and stimulatory effects of irradiation on these mitochondrial systems are a function of dosage. (auth)

29223 A CLINICAL STUDY OF IRON ABSORPTION USING ^{55}Fe AND ^{59}Fe TWO RADIOIRON ISOTOPES (KINETICS OF IRON ABSORPTION). S. Tomita, M. Yamaba, Y. Takahashi, A. Shirakawa, S. Kariyone, G. Wakisaka, and Y. Takagi (Kyoto Univ.). Radioisotopes (Tokyo), 13: 225-33(May 1964). (In Japanese)

A modified method is given for the determination of ^{59}Fe and ^{55}Fe. The ^{59}Fe activity is measured in a 2 × 2 in. NaI(Tl) crystal. This detector is not sensitive to the soft x rays of ^{55}Fe. The background is 100 cpm at efficiencies of 22% (liquid samples) and 6.5% (electroplated samples) for ^{59}Fe. The ^{55}Fe activity is measured from electroplated samples in a 3 mm × 1.75 in. NaI(Tl) crystal covered with 0.15 mm beryllium, which is preferentially sensitive to ^{55}Fe. In this condition the efficiency is 4.4% for ^{55}Fe and 5.7% for ^{59}Fe, and the background is 150 cpm. By means of a double radioisotope technique permitting determinations of the total amount of iron absorbed as well as the absorption rate, iron absorption was studied in a normal subject, in patients with iron deficiency, and in gastrectomized subjects with or without iron deficiency. When one mg radioiron as iron sulfate solution was administered orally, the shape of the plasma radioiron curve suggested that it might express the difference of two exponential functions. As a result, a different analytic method was devised to study kinetics of iron absorption. The iron absorption value calculated using this method was in good accord with that using the method of Hallberg and Sölvell. The initial absorption rate varied from 134 to 3830 μg/hr in different subjects. Significant correlation was observed between the iron absorption value and the plasma iron disappearance half time, and between the rate constant from intestine to plasma and the serum iron level. In the patients with iron deficiency, the amount of iron absorbed into plasma during several hours was larger than in normal subjects, whereas the amount temporarily stored in the mucosa was not larger. In a gastrectomized anemic patient, when ferrous sulfate was given orally, the maximal absorption rate per 15 minutes was observed during the first 15 minutes following iron administration, and the absorption was not disturbed as compared to nongastrectomized subjects, while the absorption of iron combined with egg protein was almost zero. These results may indicate that in some of gastrectomized subjects, although the ionization of iron from egg protein is disturbed, the absorption of iron salts in the intestine is not disturbed. Furthermore, the transport of iron to the intestine is rapid. (auth)

29224 THE VALUE OF CONTROL OF IODINE FIXATION BY THE THYROID IN CASE OF RADIO-CONTAMINATION. G. Legeay and M. Forgues (Laboratoire du Radiobiologie, Centre d'Instruction, Service Biologique et Vétérinaire des Armées, France). Rev. Corps Sante Armees, 2: 825-34(Dec. 1961). (In French)

Rabbits were fed a diet contaminated with ^{131}I (6×10^5 μC/cc, maximum permissible contamination in peacetime for water, × 1.5) and the thyroid studied after sacrificing the animals. Three groups of animals were studied: young rabbits fed by mothers receiving radiocontaminated rations; lactating females; nongestating, nonlactating females. The activity of thyroids in counts/min/mg for young rabbits ranged from 5 to 7.5 for animals five to seven days old to 41 to 71 for animals 24 to 30 days old. Results were scattered but the following conclusions were drawn: between the first and 20th day the thyroid builds up ^{131}I more and more gradually; after the 20th day, the fixed I increases greatly. The lactating females, mothers of the previous lot, were fed contaminated diets for 14 to 32 days. All four animals had similarly active thyroids, 21.25 counts/min/

mg, with a very slight scatter. The nonlactating females were fed from two to eight days; after the beginning of an effective period (six days) the thyroid activity was 52.3 counts/min/mg (mean of two animals sacrificed at six and eight days). The activity of the diet was 0.0126 counts/min/mg; with this as base of comparison, the value of the milk was 6; that of the lactating females' thyroids was 1680; and that of the nonlactating females' thyroids was 4150. (BBB)

29225 ACUTE TOXICITY OF THERAPEUTIC CHELATING AGENTS UTILIZABLE IN THE NUCLEAR INDUSTRY. P. Chiadot and J. Lafuma (CEN, Grenoble, France). Rev. Hyg. Med. Soc., 10: 391-401(July-Aug. 1962). (In French)

Studies are reported relating the dose of chelating agents used therapeutically after radiocontamination with toxicity of the agent. Factors influencing the toxicity of chelates are enumerated. The LD_{50} of agents was determined on adult mice and is presented as mg/g body weight. Survival times of mice injected with various amounts of EDTA Ca are listed, and causes of toxicity are discussed. (TCO)

29226 FIXATION OF I^{131} BY THE THYROID GLAND IN CIRRHOTICS. G. Mitrov and L. Balabanski. Rev. Intern. Hepatol., 13: 233-40(1963).

The fixation of ^{131}I in the thyroid gland was measured in 26 patients with liver cirrhosis of various etiology and in 5 patients with chronic hepatitis. A normal fixation of the isotope in 19 patients and a hypofixation in 12 were observed. No parallelism was observed between the etiology of the hepatic lesions, the function tests, and the hypofixation of radioiodine in the thyroid. Possible mechanisms to explain this hypofixation are discussed. (C.H.)

29227 MECHANISM OF INTRODUCTION OF STRONTIUM-90 INTO THE CALCIUM METABOLISM. R. Van Rossum. Scalpel, 116: 883-902(1963).

Of all the residual substances contained in radioactive fallout, strontium-90 appears to be the most dangerous for man. The large number of observations and repeated dosages performed in numerous places at various latitudes have made it possible to determine the relationship which exists between strontium and the other simple elements such as cesium, calcium, and potassium. It progresses insidiously through the mineral chemistry of plants into that of herbivorous animals, finally reaching the human skeleton as strontium-90 where it is fixed. It has required prolonged study and numerous observations to understand the cycle of strontium-90. Later statistics are not reassuring. Cancer experts of the whole world are worried and view the future with pessimism even if wisdom prevails and further nuclear explosions are forbidden. (Excerpta Med., Sect. XXIII, 1: No. 3, (March 1964)).

29228 RENAL TUBULAR PERMEABILITY TO RADIOACTIVE SODIUM, BROMIDE, AND IODIDE ISOTOPES. F. Kiil and K. Aukland (Universitet, Oslo). Scand. J. Clin. Lab. Invest., 14: 124-31(1962).

Previous stop-flow studies in the kidney of the dog, indicated an equilibration of ^{24}Na across the proximal tubule within 2 to 4 min after intravenous injection. In stop-flow periods of 4 to 6 min duration, however, glomerular filtration is far from stopped. Glomerular indicators of new filtrate such as inulin may, at the end of the period, have reached the distal tubule, and thus contribute to the high activity of the ^{24}Na accumulated in the tubules at the end of the stop-flow period. Therefore, care was taken in the present study not to inject the isotopes before the glomerular filtration rate was reduced to a very low level. In preliminary experiments it was shown that an average of more than 10 min complete ureteral obstruction was required before renal pelvic pressure reached maximal values. A filtration indicator was injected intravenously together with the radioisotope and another filtration indicator (ferrocyanide or inulin) one min before the release of flow. It was thus possible to ascertain whether radioactive isotopes had reached the tubular fluid through the tubular wall or through the glomerular membrane. Intravenous injections of ^{24}Na, ^{82}Br, or ^{131}I, together with glomerular indicators, were made 12 min after clamping of ureteral catheter in 10 dogs. Analyses of serial urine portions collected 3 min after the injection was started, revealed a specific activity of ^{24}Na and ^{82}Br nearly as high as that of plasma in urine portions delayed in the proximal tubules. The specific activity of ^{131}I was much lower. These observations suggest that proximal tubules are highly permeable to Na and Br ions and less permeable to I ions. The significance of passive flux of sodium under conditions when concentration gradients, electrical potential gradients and colloid osmotic pressure are changed, is discussed. It is concluded that it is only when concentration gradien.. increase, as during mannitol diuresis, that passive flux of NaCl is likely to contribute to the natriuresis. (BBB)

29229 RADIUM-226, RADIUM-228, LEAD-210, AND FLUORINE IN PERSONS WITH OSTEOGENIC SARCOMA. H. F. Lucas, Jr., (Argonne National Lab., Ill.), R. B. Holtzman, and D. C. Dahlin. Science, 144: 1573-5(June 26, 1964).

Concentrations of the naturally occurring alpha-emitting radioelements, radium-226, radium-228, and lead-210, and of stable lead and fluorine were determined in bone specimens from 32 individuals having a verified osteogenic sarcoma. Comparison of the results with those for the average person showed no significant differences in either the absorbed dose (rad) from the accumulated radioisotopes or in the concentrations of the elements studied. (auth)

29230 HUMAN BONE MARROW DISTRIBUTION SHOWN IN VIVO BY IRON-52 AND THE POSITRON SCINTILLATION CAMERA. Hal O. Anger and Donald C. Van Dyke (Univ. of California, Berkeley). Science, 144: 1587-9(June 26, 1964).

Radioactive iron, which concentrates in erythropoietic marrow, was given intravenously, and 16 hours later pictures of its distribution were taken with the positron camera. The instrument is an imaging device that produces pictures of the distribution of positron-emitting nuclides without scanning. Wide variations in the distribution of marrow were found in various diseases. (auth)

29231 STRONTIUM FIXATION BY LIME CONTAINED IN SOILS. R. Mokady and M. Gal (National and University Inst. of Agriculture, Rehovoth, Israel). Science, 145: 154-5(July 10, 1964).

The suitability of soils for the disposal of radioactive strontium waste products is determined in part by the amount and properties of calcium carbonate in the soil. Analyses of the strontium ion concentrations in the effluent solution of soil columns and x-ray diffraction patterns suggest that a fraction of the strontium ions is precipitated as strontium carbonate. (auth)

29232 ABSORPTION OF RADIOACTIVE FALLOUT PRODUCTS THROUGH NORMAL SKIN, BURNS, AND OPEN WOUNDS. W. William Salak and John M. Howard (Hahnemann Medical Coll., Philadelphia). Surg. Forum, 14: 30-2(1963).

More than 1000 adult albino rats were anesthetized and

their tails were lacerated with an unsterile (like accidental or war injuries) razor blade, or scalded in 100°C. water to produce first, second, and third degree burns. The wounds and burns were then exposed to standard aqueous solutions of ^{22}Na, ^{131}I, ^{85}Sr, $^{140}Ba-^{140}La$, $^{95}Zr-^{95}Nb$, and ^{90}Y at various days during the ensuing week. The absorption across normal skin, burns, and open wounds was determined by heart puncture and determination of radioactivity in plasma. Total-body irradiation in doses of 200 to 400 r was given to some animals prior to burn or other trauma. In attempts to prevent the absorption of radionuclides, plain bandage, furacin ointment, petrolatum ointment, rezifilm plastic spray, and vaseline gauze were used as protective dressings. The results indicate that normal skin with intact epidermis does not permit any ion transport from the solution. Even following 200- to 400-r total-body irradiation, skin permeability does not change and the skin remains impermeable to water and electrolytes. Minimal quantities are absorbed after first-degree burn. Minor variations in the absorption exist, depending on additional mechanical trauma and ulceration. The largest amounts of isotopes are absorbed following second-degree burns, where 1 μC of radioactive element can shift into the body through 1 cm^2 of burn area in 1 hr. The rate of absorption is potentially significant. Third degree burns have $\sim\frac{1}{3}$ less absorptivity as compared to second degree burns. A gradual decrease in absorption occurs across all burns as healing progresses. Fresh traumatic wounds, probably because of active bleeding and vasoconstriction, absorb less than one-day-old wounds. Across comparable surface areas, an open wound 24 hr old can absorb even more than a fresh second-degree burn. These rates were not affected by total-body irradiation. A crust or eschar covering the burn confers a natural protection for the injury which is incomplete. Studies of the various protective dressings, for the burn or wound against radioactive fallout, revealed the vaseline gauze to be the most effective. Absorption could be decreased to 2% when properly applied. (BBB)

29233 MOLECULAR WEIGHTS OF FACTOR VIII (AHF) AND FACTOR IX (PTC) BY ELECTRON IRRADIATION. David L. Aronson, John W. Preiss, and Michael W. Mosesson (National Inst. of Health, Bethesda, Md.). Thromb. Diath. Haemorrhag., 8: 270-5(Nov. 15, 1962).

During low-voltage (7-kv) electron irradiation of blood AHF (factor VIII), both human and porcine preparations lost activity at the same rate. On the basis of the target theory, the molecular weight was calculated to be 180,000. From the dose-activity curve for PTC (factor IX) the calculated molecular weight was 110,000. The molecular weight calculations were made assuming Lea's figure of 64 primary ionizations per μ of path length of a 7-kv electron in protein. Target volumes of other molecules ranging in molecular weight from 14,000 to 700,000 were estimated with the same electron accelerator, under the same conditions, and these calculated molecular weights agreed well with the accepted values determined by other techniques. (BBB)

29234 RENAL TESTS IN TOXICITY STUDIES ON RATS. T. Balazs, A. Hatch, Z. Zawidzka, and H. C. Grice (Dept. of National Health and Welfare, Ottawa). Toxicol. Appl. Pharmacol., 5: 661-74(Sept. 1963).

Renal tubular lesions were induced in rats by graded doses of uranyl nitrate, sodium chromate, and mercuric chloride, which specifically injure the proximal convoluted tubules (PCT). The degree of tubular injury was followed by determination of urinary glutamic-oxalacetic transaminase (UGOT), blood urea nitrogen (BUN), and other indices. It is concluded that in these toxicity studies the PCT is the most vulnerable part of the nephron, and the tests used in this study appeared to detect changes in this area. The UGOT measurement seems to be a reliable method for the detection of tubular injury and a useful tool for the study of comparative tubular nephrotoxicities. (BBB)

29235 TRACE METALS IN THE BRAIN IN HUNTINGTON'S CHOREA: REPORT OF THREE VERIFIED CASES. Cyril B. Courville, R. E. Nusbaum, and E. M. Butt (Loma Linda Univ., Los Angeles). Trans. Am. Neurol. Assoc., 87: 104-5(1962).

Strontium and some other trace metals were estimated in normal and pathologic human brains. See NSA 17: 35419. (BBB)

Radiation Effects

29236 (BNL-7697) PANEL ON BIOPHYSICAL CONSIDERATIONS IN NEUTRON EXPERIMENTATION. Arnold H. Sparrow (Brookhaven National Lab., Upton, N. Y.). [1963]. Contract AT-30-2-GEN-16. 20p. (CONF-205-14).

From International Atomic Energy Agency Symposium on the Biological Effects of Neutrons Irradiations, Upton, N. Y., Oct. 1963.

Data are summarized on the nuclear volume, somatic chromosome number, and radiation mortality data for 16 species of plants, calculated amount of energy absorbed per interphase chromosome at the lethal exposure level, and the relation between nuclear volume, DNA content, and RBE for various microorganisms and plant cells. The data indicate that RBE increases as DNA content per nucleus increases and as the average interphase chromosome volume increases when γ rays and fission fast neutrons are compared. It is postulated that this relation between DNA content or chromosome volume and radiosensitivity may also be found in animals. (C.H.)

29237 (BNL-8004) STUDIES ON THE KINETICS AND RADIOSENSITIVITY OF MERISTEMS. A. H. Sparrow and J. Van't Hof (Brookhaven National Lab., Upton, N. Y.). [1963]. Contract AT-30-2-GEN-16. 4p. (CONF-556-1)

From 12th Annual Meeting of the Radiation Research Society, Miami, Fla., May 1964.

Simple mathematical models that elucidate the relationships between root growth rate and cell production were used to investigate alterations in cell production and root growth rate following irradiation. Cultured pea seedlings chronically exposed to γ irradiation for 3 days showed a reduced growth rate and a loss of root tip meristematic cells. The mitotic cycle duration, as measured by the colchicine method, showed no increase. It was concluded that the decreased growth rate and the reduced size of the active meristem resulted from a decrease in the number of proliferating cells and that irradiated cells that do divide maintain a mitotic cycle duration equal to that of the non-irradiated control until sufficient damage accrued to produce a loss of reproductive integrity. These data and those from additional radiosensitivity experiments on pea seedling roots and Tradescantia indicated that the apparent increased resistance associated with dormancy could be attributed primarily to a decreased chromosome volume. (C.H.)

29238 (COO-119-229(p.2-57)) INJECTION TABLES [FOR RADIOISOTOPES IN DOGS]. (Utah. Univ., Salt Lake City. Coll. of Medicine).

Data are presented on the long-term effects of injections of various doses of ^{226}Ra, ^{239}Pu, ^{228}Ra, ^{228}Th, and ^{90}Sr in beagles. Data are included on the dose injected, age at injection, radiation dose to the skeleton, age at death, age of living dogs, and lesions or factors that had the most pronounced effect on the clinical status or death of each animal. (C.H.)

29239 (COO-119-229(p.59-73)) RADIATION INDUCED TURBINATE ATROPHY. Glenn N. Taylor, Webster S. S. Jee, and Walter Angus (Utah. Univ., Salt Lake City. Coll. of Medicine).

Radioinduced maxilloturbinate atrophy was observed in dogs injected with ^{226}Ra, ^{228}Ra, ^{228}Th, or ^{239}Pu some 3 to 7 yr before death. Gross and microscopic features of this condition are presented. Involution following ^{90}Sr injection was not observed. (C.H.)

29240 (COO-119-229(p.80-92)) THE EFFECTS OF IONIZING RADIATIONS ON ENDOCRINE CELLS. III. RESTORATION OF TESTOSTERONE PRODUCTION WITH A REDUCED NICOTINAMIDE ADENINE DINUCLEOTIDE PHOSPHATE GENERATING SYSTEM AFTER LOCALIZED IRRADIATION TO HEADS OF RATS. LeGrande C. Ellis and David L. Berliner (Utah. Univ., Salt Lake City. Coll. of Medicine).

Male rats (Sprague-Dawley strain) were given 1500 r x irradiation to their heads when 12 weeks of age. Twenty days after irradiation, the animals were euthanized and testicular tissue was removed from both the control animals and the irradiated animals. These tissues were incubated with 5-pregnelolone-7α-H^3 and progesterone-4-C^{14}, and tissues from each group of animals were incubated with a NADPH-G-S and without a NADPH-G-S. In the irradiated group of animals, less testosterone was produced in vitro than for control animals. Similarly, there was less tritium in this testosterone fraction, and the tritium/carbon-14 ratio for testosterone was also diminished. The addition of a NADPH-G-S to incubations of testicular tissue from irradiated animals restored the diminished testosterone production, the altered tritium/carbon-14 ratios, and the tritium content of testosterone to levels equal to that for similarly treated control animals. These alterations in the biotransformations of steroids by testicular tissue from irradiated rats was attributed to the pituitary's secretion of gonadotropins. These data also show that the biotransformation of steroids by testicular tissue may be altered even though the histologic or outward appearance of these cells would indicate that they are normal. (auth)

29241 (COO-119-229(p.93-110)) SERUM TRANSAMINASE LEVELS IN BEAGLE DOGS BURDENED WITH Pu^{239}. Walter Stevens and David L. Berliner (Utah. Univ., Salt Lake City. Coll. of Medicine).

Serum glutamic oxaloacetic and glutamic pyruvic transaminase were measured in dogs injected with ^{239}Pu in dose levels ranging from 0.0157 to 2.91 μC/kg. A significant difference in SGPT between males and females of the control group was demonstrated. There was no significant difference between the SGOT values of the males and females. There was a correlation between the injected dose of ^{239}Pu and the per cent of SGOT and SGPT measurements that were elevated. The increase in SGOT and SGPT in Pu-burdened dogs is attributed to the significant deposition of the ^{239}Pu in the livers of these animals. (auth)

29242 (TID-20728) PROGRESS REPORT [ON GENETICAL STUDIES], OCTOBER 1, 1963–JUNE 1, 1964. Theodosius Dobzhansky (Rockefeller Inst., New York). Contract AT(30-1)-3096. 10p.

Progress is reported in studies on genetic loads in natural populations of Drosophila pseudoobscura. Estimates were made of the fitness of 4 polymorphic and for 6 corresponding monomorphic populations of D. pseudoobscura at 25° and 16°C. The experimental populations improved their adaptiveness to their environment but did so by means of a betterment in fecundity in spite of a deterioration in longevity and no change in viability or speed of development. Preliminary results of studies on populations with radiation histories suggest that at least some of the lethals and semilethals preserved in the irradiated population after natural selection over 28 to 37 generations are neutral or heterotic in heterozygous conditions. (C.H.)

29243 (TID-20774) A PILOT STUDY TO INVESTIGATE THE EFFECTS OF X IRRADIATION ON THE COURSE OF PATHOGENESIS OF VIRAL DISEASES, AS STUDIED BY IMMUNO-FLUORESCENCE. Final Report. William Daniel Kundin (Kansas. Univ., Kansas City. School of Medicine). May 31, 1964. Contract AT(11-1)-1179. 12p.

Progress is reported in studies on the pathogenesis of viral diseases in weanling mice subjected to various stresses. Cortisone, nitrogen mustard, urethane (2 radiomimetic drugs), 6 mercaptopurine (a radiotherapeutic drug), and carbon tetrachloride (a liver poison) all failed to influence Reovirus pathogenesis. However, when used in conjunction with x irradiation the susceptibility of mice to Reovirus infection increased markedly in cortisone and nitrogen mustard treated mice, less markedly in urethane treated mice, and weakly in 6 mercaptopurine and carbon tetrachloride treated mice. Fluorescent antibody patterns were similar in all treated mice. The liver and to a lesser extent the liver capsule, leptomeninges, and pancreas were generally the only tissues containing demonstrable antigen. Although antigen was observed more frequently in infected mice receiving both drug and x ray, the antigenic pattern was similar to that observed in mice receiving only x radiation. (C.H.)

29244 (TID-20780) CATALASE INACTIVATION BY 4.9- TO 7.5-Kev FLUORESCENT X RAYS (thesis). John William Baum (Michigan. Univ., Ann Arbor. School of Public Health). May 1964. Contract AT(11-1)-1205. 84p.

Crystalline and lyophilized beef liver catalase solutions, with protein concentrations of 16.8 to 100 mg/l, were irradiated with fluorescent x rays of 4.9 to 7.5 kev energy. The dose required for 50% inactivation increased gradually over this energy range. No activation was observed at low doses. Both crystalline and lyophilized catalase solutions were dose-rate dependent in the range of 65 to 1200 rad/hr. In this range, the LD_{50} doses were best expressed by an equation of the form: $LD_{50} = (A + BR)$ rads, where A and B are constants which appear to depend on type of enzyme or on concentration, and R is dose rate. Little dose-rate dependence was observed for lyophilized catalase in the range 7,900 to 40,000 rad/hr. Doses required for 50% inactivation of lyophilized catalase solutions ranged from about 13,000 to 120,000 rads. For crystalline catalase solution LD_{50} doses ranged from about 10,000 to 67,000 rads. Scotch tape, immersed in the enzyme solutions, protected both crystalline and lyophilized solutions exposed to hard x rays. It was concluded from these results that solutions of beef liver catalase do not have signigicant energy dependence in the region of the iron k-absorption edge. (auth)

29245 (TID-20783) THE DESIGN, SHIELDING, AND PRELIMINARY DOSIMETRY FOR A NEUTRON IRRADIA-

TION FACILITY TO STUDY SPERMATOGENESIS IN MAN (thesis). Kenneth Lawrence Swinth (Washington. Univ., Seattle). 1964. 115p.

A neutron irradiation facility was designed for use in studies of the effects of neutrons on spermatogenesis in man. Uniform neutron doses in the range of 10 to 100 rads will be delivered to the testes of subjects by means of a neutron generator that utilizes both the $T(d,n)^4He$ (14-Mev neutrons) and $D(d,n)^3He$ (2.6-Mev neutrons) reactions. The design, shielding, and preliminary dosimetry of the facility are described. (C.H.)

29246 (TID-20784) A STUDY OF TWO-HIT ABERRATIONS IN HAPLOPAPPUS AS SCORED AT METAPHASE (thesis). Paul O. Matthews (Kansas. Univ., Lawrence. Graduate School). May 1964. 66p.

The effects of day-night and constant illumination conditions on the mitotic activity in Haplopappus gracilis, a small yellow-flowered desert annual, was observed. It was found that with constant illumination there was a marked decrease in the periodicity of the mitotic activity, and that a fairly constant level of mitotic activity could be attained after approximately 100 hr of exposure to illumination. H. gracilis seedlings were irradiated with x rays and the frequencies of chromosome aberrations which arrived at metaphase were determined during the period of 1 to 35 hr after irradiation, by obtaining separate consecutive samples of metaphases accumulated by a solution of 0.002 M 8-quinolinol with 0.0025% colchicine. The relation between the frequency of two-hit chromosome aberrations was determined for three different x-ray exposures. It was found that the frequency of dicentric and ring chromosomes scored at metaphase increased approximately as the second power of the magnitude of radiation exposure. Analysis of the data revealed the relationship to be $Y = 1.9055 \times 10^{-5} D^{1.95}$, where Y is the frequency of aberrations in percent and D is the irradiation dose. (auth)

29247 (TID-20785) SOME FACTORS WHICH INFLUENCE THE SENSITIVITY OF ESCHERICHIA COLI B/R TO RADIATION (thesis). James H. Metcalf (Kansas. Univ., Lawrence. Graduate School). May 1964. 63p.

Results are reported from a study of the relative biological efficiency (RBE) of 14-Mev neutrons and 250-kvp x rays on Escherichia coli B/r. The effects of various post-irradiation treatments on the survival of the irradiated bacteria were also studied. The data indicate that the RBE of neutrons can vary over a wide range, dependent on the cultural conditions. The data also indicate that radiation damage may be of two types. A certain amount of damage was observed regardless of the medium on which the cells were plated and in addition there was damage from which the cells were able to recover if growth conditions were favorable. (C.H.)

29248 (TID-20786) EFFECT OF X-IRRADIATION AND CERTAIN OTHER TREATMENTS ON BLOOD BRAIN BARRIER PERMEABILITY. V. Nair and L. J. Roth. ENHANCEMENT OF THE ANTICONVULSANT ACTION OF ACETAZOLAMIDE FOLLOWING HEAD X-IRRADIATION AND ITS RELATION TO BLOOD BRAIN BARRIER CHANGES. V. Nair, H. Sugano, and L. J. Roth (Chicago. Univ.). [196?]. Contract AT(11-1)-847. 53p.

Part I. The effects of x radiation, metrazol seizure, osmotic imbalance, and anoxia on the blood-brain barrier in rats were studied by means of a frozen state dissection method and autoradiography employing ^{131}I-RISA and ^{35}S-sulfate, which have specific distribution properties in the central nervous system. Results indicate selective injury to discrete anatomical regions of the brain. In general, permeability of the barrier was less affected by 10,000 r x irradiation than by metrazol-induced seizure or osmotic imbalance produced by glycerol. Part II. X irradiation of the head of rats was found to enhance the anticonvulsant action of acetazolamide. In irradiated animals stimulation of the sensory-motor cortex elicited only mild seizure discharges and the evoked discharges were completely suppressed by a dose of acetazolamide that was ineffective in control animals. Penetration of ^{35}S-acetazolamide was found to be increased in four discrete regions of the brain at 48 hr post-irradiation. Increase in brain drug content was found to be temporally related to the pharmacological effects manifested in the irradiated animal. It was concluded that x irradiation had induced selective blood-brain barrier permeability changes, thus permitting an increased selective penetration into the brain of the normally slow penetrating drug, acetazolamide. (C.H.)

29249 (TID-20815) WAVELENGTH-DEPENDENCE OF HORSERADISH PEROXIDASE INACTIVATION BY SOFT X-RAYS (thesis). Peter Paraskevoudakis (Michigan. Univ., Ann Arbor. School of Public Health). May 1964. Contract AT(11-1)-1205. 130p. (ORA-05222-2-T)

Horseradish peroxidase (HRP) solutions with protein concentration of 3.3×10^{-7} M were irradiated with monochromatic x rays of 5 to 9 kev photon energy. Results indicated that the radiation damage spectrum of HRP in solution displays an energy dependence in this photon energy range, that the inactivation of dilute HRP solutions by Ni fluorescent radiations is independent of dose rate in the range from 645 to 64,000 rads/hr, and that soft x rays attack and destroy the porphyrin ring. It was concluded that the active site of HRP depends on the porphyrin molecule, its position on the protein molecule surface, and the tertiary structure of the protein molecule. Possible modes of HRP inactivation are discussed. The peroxidase system is compared with the catalase system from a biochemical point of view. (C.H.)

29250 (AEC-tr-6429) DIFFERENCES IN SENSITIVITY TO GAMMA RADIATION IN DROSOPHILA OF THE WILLISTONI GROUP. G. Carvalho and M. P. da Cruz (Brazil. Universidade, Rio de Janeiro. Faculdade Nacional de Filosofia). [nd]. (A translation).

Three morphologically-similar strains of Drosophila were compared. Drosophila willistoni, D. equinoxialis, and D. paulistorum all exhibited differences in effects of 3,000 r x radiation on viability, sex-ratio factor, and response to temperature. (C.H.)

29251 CHANGES OF RADIATION RESISTANCE IN ESCHERICHIA COLI B. Vera Mannardt-Kutas (Inst. for Radiobiological Research, Budapest). Acta Biol. Acad. Sci. Hung., Suppl. 5: 71(1963).

Strains resistant to 1500, 2000, and 2500 I. U./ml penicillin were produced from E. coli B by using Szybalski's gradient plate technique. Multisegmented bacterial filaments were formed under the influence of the penicillin treatment. Radiation sensitivity of the penicillin-untreated and the pencillin-resistant strains was compared, using x radiation of high dose intensity (13,640 r/min). From measurement of the effect of ionizing radiation on percent survival, radiation resistant of penicillin-resistant strains was significantly higher, than of the strains not treated with penicillin. Radiation resistance was the highest in a strain which was resistant even to 2500 I. U/ml penicillin. (BBB)

29252 ON THE EFFECT OF X RAYS ON GROWTH, CELLULAR DIVISION, AND NUCLEIC ACID METABOLISM OF ESCHERICHIA COLI B. W. Finck and I. Eckardt (Friedrich Schiller Universität, Jena, Ger.). Acta Biol. Med. Ger., 12: 283-96(1964). (In German)

Experiments previously conducted on the effects of the radiomimetic compounds ethyl urethane and nitrogen mustard on DNA, RNA, and protein synthesis in this bacterium were repeated using ionizing radiation. The cells were exposed to 200-kv x rays at 4°C in a chemically defined medium. After x irradiation of an exponentially growing culture of E. coli by 8500 r at a rate of 500 r/min, at a cell concentration of 0.5×10^9 cells/ml medium, the number of cells remained constant for several hours, after a slight increase by about 20%; whereas the cell mass increased. The subsequent increase in the number of cells corresponded roughly to the increase of the cells able to form colonies on agar plates. In the culture growing after irradiation under normal conditions the protein content/ml medium increased ~ exponentially. Immediately after irradiation the DNA content was still normal; in the course of the following 30 min it decreased, normalizing finally after 60 min. The RNA content showed marked three-phase change, characterized by rise, plateau, and renewed rise. During the growth period the composition of the long, thread-like cells changed in a characteristic way, differing from the normal cells. As was shown by ^{32}P-phosphate turnover measurements, DNA synthesis began shortly after irradiation, although the DNA concentration decreased during this time. The RNA synthesis corresponded to the RNA-concentration increase during the same period. Upon entrance into the plateau phase, with its unchanged concentration, and in the subsequent concentration increase, intense RNA turnover could be observed. However, this was true only for the cultures, not for the individual cell. (BBB)

29253 INACTIVATION OF DRIED BACTERIA AND BACTERIAL SPORES BY MEANS OF IONIZING RADIATION. Ebbe Ahrensburg Christensen and Niels W. Holm (Statens Seruminstitut, Copenhagen). Acta Pathol. Microbiol. Scand., 60: 253-64(1964).

Dried spores of Bacillus subtilis, Bacillus globigii, and Bacillus pumilus and dried cells of Staphylococcus aureus, Micrococcus radiodurans (strains R_1 and S-8), and Corynebacterium were exposed to ^{60}Co γ radiation. The inactivation curve for B. subtilis spores (log number of survivors vs dose) was linear over its entire course from 0 to 1.8 Mrad γ radiation. The resistance of spores of B. globigii and B. pumilus did not deviate from the mean resistance of the B. subtilis preparations. As was anticipated, the inactivation curves for S. aureus and a randomly chosen contaminant (a coryneform rod) were much steeper than the curves for spores. The resistance of various preparations did not vary significantly among themselves, and the slope of the inactivation curves was independent of whether 10^5 or 10^8 bacteria were used. M. radiodurans strains were more resistant than the spore preparations examined, and the inactivation curves showed a nonlinear course. Both strains of M. radiodurans showed very high resistance to ionizing radiation in the dry state. The number of viable units were only reduced by a factor of 50 or less or 2.5 Mrad. With B. subtilis spores, the fraction of survivors after irradiation was unaffected by variations in storage temperature between 0° and 37°C. Illumination (daylight) between one and five days caused no reactivation of the spores. (BBB)

29254 INTRAUTERINE IODINE METABOLISM. L. Lampe, L. Kertesz, F. Peter, and L. Medveczky (Medical Univ., Debrecen, Hungary). Acta Physiol. Acad. Sci. Hung., 20: 11-22(1961).

Fetal iodine metabolism was studied in 52 pregnant rats weighing 200 to 240 g and in their 341 fetuses. On the 14th to 21st days of gestation 10 μC of carrier-free ^{131}I was injected into the femoral vein of the pregnant animals. Twenty-four hr later the activity of the maternal thyroid gland, the total fetal and placental activity, and the radioiodine contents of the fetal thyroid were determined. In two other groups of animals, methylthiouracil treatment was started on the 8th day of pregnancy, or partial thyroidectomy was performed. It was shown that the fetal iodine uptake rapidly increased from the 18th to 19th days of pregnancy onward and reached 15 to 16% of the administered amount on the 21st day. The fetal and placental activity ratio varied in favor of the latter until the 18th day of gestation, the two activities were nearly identical on the 18th and 19th days, while during the last two days the fetal radioiodine level was two to 16 times higher than the placental activity, indicating a sharp increase in fetal thyroid activity. The increase in fetal iodine uptake was due not to the gain in weight since iodine uptake exceeded the gain in weight, thus pointing to definite increase in thyroid activity. Methylthiouracil treatment reduced not only the maternal, but also the fetal iodine uptake. In response to partial thyroidectomy, fetal iodine uptake increased and was initiated earlier than in the controls. (BBB)

29255 Cx-REACTIVE PROTEIN IN X-IRRADIATED ANIMALS AND IN OTHER PATHOLOGIC CONDITIONS. Jozef Panasewicz and Zofia Gloskowska (Inst. of Hematology, Warsaw). Acta Physiol. Polon., 15: 173-88(Mar.-Apr. 1964). (In Polish)

The influence of ionizing radiation on blood levels of Cx-reactive protein (CxRP) in rabbits was studied. Fifteen animals were irradiated with 500- or 1000-r doses of x rays. CxRP levels were determined with the rapid quantitative method of titration on glass slides described by Hyland. Presence of Cx-reactive protein in healthy rabbits was not found. In the serum of rabbits submitted to 500 or 1000 r of x rays CxRP appeared, in most cases within 24 hr after irradiation. The reaction had a biphasic character. A primary rise in CxRP was observed immediately after irradiation, and a secondary rise on subsequent days. Levels of CxRP varied in different rabbits in direct proportion to the dosage of x rays. In reversible cases of postradiation disease serum levels of CxRP diminished during convalescence, and disappeared after the recovery of the rabbits. In irreversible postradiation disease the levels gradually increased, reaching a peak in the preagonal period. An influence of tissue trauma during withdrawal of blood in the experimental rabbits was eliminated. Injection of purified bacterial pyrogens or of heterologous blood caused appearance of CxRP, while starvation and administration of 6-mercaptopurine had no effect in the irradiated animals. The dynamics of the changes in CxRP levels in rabbits may serve as a diagnostic and prognostic test in evaluating the course and intensity of acute postradiation disease. (auth)

29256 COMPARATIVE STUDY OF METHODS OF ASSESSING SURVIVAL OF VARIOUS SPECIES OF ANIMALS AFTER X-IRRADIATION. Jozef Panasewicz, Zofia Gloskowska, Maria Grabarczyk, Krystyna Marczak, Aleksander Przybylski, and Ewa Zawidzka (Inst. of Hematology, Warsaw). Acta Physiol. Polon., 15: 189-204(Mar.-Apr. 1964). (In Polish)

Radiosensitivity varies, depending on the genus, species, sex, and age of living organisms, and on the dosage of ioniz-

ing radiation administered. Experiments were carried out with 455 dogs, cats, rats, mice, and rabbits. The animals were submitted to single whole-body irradiation, or with screening of the head and trunk, from a therapeutic x ray unit with doses of 300 to 15,000 r. It was found that laboratory animals can be classified with respect to sensitivity to the dose of 600 r of x rays in the following order, beginning from highest radiosensitivity: dogs, cats, rats, mice, and rabbits. In spite of the high survival rate, rabbits showed the highest sensitivity to the dose of 600 r of ionizing radiation, exhibiting a high percentage of early reactions and postradiation shock. In rats and mice the survival rate diminished in proportion to increasing dosage of radiation. A similar relationship was not found in rabbits, in which the degree of radiosensitivity was highly individualized. High doses of x rays of the order of 1000 or 15,000 r applied to various areas of the body in rats showed the shortest survival time after irradiation of the head, longer after whole-body irradiation, and longest after exposure of the trunk with screening of the head. The findings are discussed from the standpoint of the pathogenetic mechanisms involved. (auth)

29257 BIOLOGICAL EFFECT OF STRESS FOLLOWING IONIZING RADIATION. J. J. Gambino (Northrop Space Labs., Hawthorne, Calif.), L. R. Bennett, M. S. Billings, and B. G. Lamson. Aerospace Med., 35: 220-4(Mar. 1964).

Experiments were undertaken to study the effects of repeated stress-producing stimuli which were administered following recovery from a single total-body exposure to ionizing radiation, and to test the hypothesis that if subtle changes in adrenal function, or incipient adrenal dysfunction exist following sublethal irradiation, pathologic symptoms might be precipitated by subjecting the animal to stress-producing stimuli. Daily exposure of totally irradiated, adrenal irradiated, and nonirradiated rats to brief periods of cold was initiated several months after irradiation and continued until death. Radiation was delivered in a single 500-r dose at four months of age, and at eight months of age one-half of the survivors of the two irradiated groups and one half of the nonirradiated control group were subjected to 0° ± 1°C temperature three hours daily until death. A control group was maintained at 25°C. Whole-body irradiation alone caused reduced longevity, retarded growth, cataracts, accelerated onset of skin ulcers, greying, enlarged mammary glands and palpable tumors, and increased incidence of tumors. In contrast, a 500-r dose administered locally to the adrenals produced no significant effects. Cold exposure, administered as a mild stressing agent, had no significant effects on the normal course of any radiation-produced pathology. However, cold exposure did cause a slight reduction in accelerated tumor onset normally seen in totally irradiated animals. This reduction was most apparent at 17 and 18 months of age. No observable pathologic conditions were precipitated in adrenal irradiated animals as a result of the cold treatment. The results indicate that the adrenals are remarkably radioresistant, as judged by both histologic and functional changes. In man, dose levels as high as 2000 r to the region of the adrenals is well tolerated, and results of adrenal irradiation in rate corroborate this observation. No reports could be found in the literature of either acute or late effects resulting from local irradiation to the adrenals. (BBB)

29258 SIGNIFICANCE OF COMBINED STRESSES OF G-FORCES AND IRRADIATION. Robert W. Zellmer, Granville J. Womack, Richard C. McNee, and Ralph G. Allen, Jr. (School of Aerospace Medicine, Brooks AFB, Tex.). Aerospace Med., 37: 636-9(July 1963).

Various groups of Sprague-Dawley rats were alternately exposed to whole-body ^{60}Co γ radiation and G forces (positive or negative) to evaluate a possible synergistic effect between these treatments. The radiation doses varied from 600 to 900 r and the G forces from −3 to 15 G. Construction of the centrifuge and irradiation unit is described and illustrated. All sets of data were subjected to probit analysis. With all curves for combinations of irradiation dose and G dose, that gave an $LD_{50/30}$ as determined from fitted equations, there was an increase in irradiation dose with an increase in G dose; that is, the LD_{50} for irradiation increased with an increase in G dose. Thus, the stress due to the G dose appears to give a protective effect against irradiation dose. This effect is probably a near linear effect, at least in the range of G doses investigated. In light of the other experiments, this large variability was probably a chance event, rather than a real effect. Estimates of the $LD_{50/30}$'s ignoring G dose vary from 628 to 837 r. It is concluded that for all combinations of irradiation dose and G dose used, there was a similar, though not significant, pattern of increasing $LD_{50/30}$ for irradiation with an increase in G. Further experimentation using longer periods of latency between the G dose and exposure to irradiation might show a greater protective effect. Similarly, after exposure to irradiation, resistance to greater G forces may be possible after a latent period of longer duration. It is inferred from these experiments that there is no detrimental additive effect from the combined exposures of acceleration and radiation. To the contrary, there is a trend in the data which indicates the G forces may, in fact, protect in some undetermined manner against the effects of radiation. (BBB)

29259 ON THE EFFECT OF IONIZING RADIATION UNDER THE INFLUENCE OF HYPOXIA AND HYPOTHERMIA. Heribert Braun (Universität, Wurzburg, Ger.). Aertzl. Forsch., 16: I635-7(Dec. 10, 1962). (In German)

The effects of hypoxia and hypothermia on survival of rats exposed to 600 r were investigated. An increased mortality observed in animals irradiated following hypoxia was attributed to interference with cellular metabolic oxidative processes. Hypothermia did have some radioprotective influence. The degree of protectiveness was dependent on the temperature to which the body was cooled, but hypothermia was not useful if prolonged. (H.M.G.)

29260 COMPARISON OF MEASUREMENT OF FAT ABSORPTION USING ^{131}I- AND ^{14}C-LABELED FATS. Benjamin Rothfeld and Joseph L. Rabinowitz (Veterans Administration Hospital, Perry Point, Md.). Am. J. Digest. Diseases, 9: 263-7(Apr. 1964).

Previous studies have shown in animals that ^{14}C-labeled fat gives higher reliability data than the corresponding ^{131}I-labeled materials in the quantitative measurement of intestinal absorption. Attempts were made to confirm this finding in man by comparison of results obtained by use of ^{131}I- and ^{14}C-labeled fats in the malabsorption syndrome produced by Neomycin in elderly male psychiatric patients in good physical condition. ^{14}C-labeled fat appeared to give much better measurements in cases of steatorrhea than ^{131}I-labeled fat. This might be due to impurities in the ^{131}I-labeled fat; another possible explanation is the fact that, unlike ^{131}I, ^{14}C represents an atom found normally in the fat molecule. Because of this difference ^{14}C-labeled fat might be handled in a more physiologic manner than ^{131}I-labeled fat. The ^{14}C label is, however, impractical for general

usage because of the high cost, the time-consuming isolation required, and the difficulty of the assays. (BBB)

29261 THE REMAINING KIDNEY IN IRRADIATED SURVIVORS OF WILMS'S TUMOR. Jerome M. Vaeth (Univ. of California, San Francisco). Am. J. Roentgenol., Radium Therapy Nucl. Med., 92: 148-51(July 1964).

The intravenous urograms of 10 patients who had survived 5 years after irradiation for Wilms's tumor were studied for kidney size and configuration. The diseased kidney had been removed by nephrectomy. The remaining kidneys had been subjected to varying doses of ionizing radiation at the time the area of the diseased kidney was irradiated. In none was there evidence of atrophy. All were within the range of expected normal size and most of them were enlarged. (auth)

29262 GROSS EFFECTS ON RABBIT EMBRYOS AND MEMBRANES OF X IRRADIATION IN THE BLASTOCYST STAGE. Ottilie R. Inman and C. R. Markivee (Galesburg State Research Hospital, Ill.). Anat. Record., 147: 139-47(Sept. 1963).

The effects of x irradiation on the preimplantation rabbit embryo were studied by irradiating rabbit blastocysts in right uterine horns of does with 150 r or 200 r at 3.5 days of gestation, and comparison with untreated litter mates at 9.5 days. Irradiation increased pre-implantation mortality and significantly reduced average embryonic size. Mortality was elevated 11.1% in each irradiated group, but stunting increased with increased irradiation. In stunted embryos, experimental or control, the allantois usually failed to make uterine contact. Living irradiated embryos examined in utero frequently had areas of the yolk sac in which no blood could be seen. In both extra-embryonic and intra-embryonic vessels, their blood was distinctly paler than that of controls. Damage to hematopoietic tissue is probably a frequent result of prenatal irradiation. It is concluded that x irradiation of the rabbit blastocyst produces results similar to those reported for other species irradiated prior to gastrulation. Mortality was increased and gross malformations were few, the typical survivor being subnormal in size but grossly normal in differentiation. Not previously reported for the mammalian embryo, however, are abnormalities of the allantois and yolk sac, the latter resulting in a grossly visible hemoglobin deficiency of the young embryo. It is probable, therefore, that irradiation has a general effect on embryonic hematopoietic tissue, and that anemia should be considered as a factor contributing to increased mortality and stunted size in radiation-damaged embryos. (BBB)

29263 THE NEOBLAST AND PHENOMENA OF INDUCTION AND INHIBITION IN REGENERATION OF PLANARIA. Etienne Wolff and Theodore Lender (College de France, Paris). Annee Biol., 38: 499-529(Sept.-Oct. 1962). (In French)

A study was undertaken to determine the nature of the elements forming the regeneration blastema and their differentiation mechanism by the use of local irradiation of the planarian Dugesia lugubris and in vitro culture of the blastemas. It was shown that whole-body x irradiation with 5000-r doses of planarians prevents their regeneration, the animals dying after three to seven weeks. The same dose applied anterior to the pharynx produces necrosis and complete elimination of this region. If, following irradiation of this same part of the animal, the region of the head behind the eyes is sectioned, the results are very different. The lesions in the irradiated region progressively heal and a regeneration bud appears after a delay of 15 to 20 days in specimens maintained at a temperature of 15°. This regeneration period is seven days longer than that of the nonirradiated planaria. Regeneration is delayed for periods up to 60 to 102 days when irradiation is applied to more extensive regions and is accompanied by amputation of the head. In another experiment, when the animal was totally irradiated and a fragment of a healthy planaria was grafted on to the center of the irradiated animal, the amputated head was able to regenerate in 15 to 35 days. It is concluded that by the use of radiation it is possible to completely separate the cells responsible for regeneration from other somatic cells. These neoblasts apparently have multiple potentiality (and perhaps total) and constitute the regeneration blastema, which can be considered as a graft of undifferentiated embryonic tissue upon an adult organism. (BBB)

29264 BASAL CELL EPITHELIOMA AND CHRONIC RADIODERMATITIS. Paul Lazar and Stanley I. Cullen (Northwestern Univ., Chicago). Arch Dermatol., 88: 172-5(Aug. 1963).

Squamous cell carcinoma was reported to be the usual tumor occurring in areas previously treated by x ray, but the present study shows that basal cell epitheliomas often arise in chronic radiodermatitis. Eighteen patients previously treated with x ray, 16 of whom had chronic radiodermatitis, developed 108 different basal cell epitheliomas. The histories, clinical findings, and number of tumors in these patients support the association of late radiation effects and basal cell epithelioma formation. The relations suggest that the sites of radiodermatitis may determine whether basal or squamous cell epitheliomas follow. It is emphasized that the reported tumors occurred in areas of frank, chronic radiodermatitis (with two exceptions) and not after minimal exposure to ionizing radiation. (BBB)

29265 STUDY OF BLOOD PROTEIN CHANGES IN PARTIALLY HEPATECTOMIZED WHITE RATS SUBJECTED TO ROENTGEN IRRADIATION IN SMALL DOSES. I. TOTAL PROTEINS. A. Pannella and F. A. Paolini (Università, Pavia, Italy). Arch. "De Vecchi" Anat. Patol. Med. Clin., 35: 675-81(Aug. 1961). (In Italian)

The middle and left lobes of the liver were removed from female rats, which were divided into groups of controls, animals locally irradiated over the liver region with 25 r, 50 r, and 80 r, and animals whole-body irradiated with 80 r. After 24 hr the first group of animals was sacrificed by heart puncture and blood samples were examined; thereafter, blood samples were taken every 24 hr until the ninth day. The analysis of serum proteins was carried out using a total determination of protein by the biuret method of Kingsley-Gornall, and by electrophoretic separation of proteins. In all of the groups examined, there was no large alteration in total serum proteins; the normal value of 5.70 ± 0.04 g/100 ml was not affected by operative trauma or by the dose, or type of irradiation. Hepatectomy alone produced a depression in albumin; the globulins increased, and of these the α_1 and γ fractions were least influenced by operative trauma. Total irradiation given in one dose did not produce differences from the results in the hepatectomized animals. Focal liver irradiation did not produce a significant change in total serum protein relative to controls, but after 50 and 80 r local irradiation there was an increase in the ratio of β-globulin to α_2-globulin. A brief discussion of the significance of this result is given, particularly of the effect of irradiation of the regenerating liver on its ability to synthesize serum proteins, especially albumin. (BBB)

29266 THE INFLUENCE OF COBALT-60 GAMMA RADIATION ON AEROBIC BACTERIAL RESPIRATION.

W. Ritzerfeld, E. Schnepper, and D. H. Winterhoff (Universitat, Munster, Ger.). Arch. Hyg. Bakteriol., 148: 206-16(Apr. 1964). (In German)

The effect of γ irradiation on the oxygen consumption of four bacterial species (Staphylococcus aureus SG 511, Escherichia coli 1820, Pseudomonas aeruginosa, and Bacillus subtilis) was measured by use of the Warburg apparatus. The bacteria were irradiated in Petri dishes with Plexiglas covers at a dose rate of 228 r/min for one to 24 hr to give total doses of 13,680 to 328,320 r. With all four species, irradiation reduced O_2 consumption in a dose-dependent fashion and reduced the level of maximum respiration reached in the cultures. The spore-forming bacterium, Bacillus subtilis, showed the greatest resistance to irradiation and Pseudomonas the greatest sensitivity relative to respiration inhibition. After five-hr (68,000-r) irradiation Pseudomonas cultures failed to exhibit detectable respiration, and the same was true of Escherichia coli after 24-hr (328,320-r) irradiation. Both Staphylococcus and B. subtilis survived 24-hr irradiation but O_2 uptake did not become maximal until 12 and 7 hr, respectively, after irradiation as compared with one and two hr lag periods to reach maximal O_2 uptake in control cultures. With Staphylococcus it was possible to accelerate recovery of respiration by culture of the irradiated bacteria on a sheep blood agar plate before growth in broth was attempted. The results confirmed that the number of surviving bacteria is an exponential function of the radiation dose; that is, with increasing doses, relatively fewer bacteria survive. (BBB)

29267 HISTOCHEMICAL STUDIES ON THE ACTIVITY OF SOME ENZYMES IN THE HEART MUSCLE DURING DIFFERENT STAGES IN THE DEVELOPMENT OF ACUTE POSTRADIATION DISEASE. Jan Jonek and Stanislaw Kosmider (Clinic of Internal and Occupational Diseases, Silesian School of Medicine, Zabrze). Arch. Immunol. Therapi. Exptl., 12: 232-41(1964).

Twenty-four hours after irradiation of guinea pigs with a dose of 400 r x radiation an increase in the activity of the respiratory enzymes DPNH diaphorase and succinic dehydrogenase was observed in heart muscle, followed by a decrease in later stages. ATPase and alkaline phosphatase showed increased activity after irradiation, followed after several days by a decrease. The reaction of acid phosphatase was increased proportionately to the development of radiation disease, presumably in connection with degenerative lesions in the sarcoplasma of heart muscle fibers. Activity of nonspecific esterases diminished in the course of the experiment, and that of esterases resistant to E-600 gradually increased. These changes were attributed to increased proteolytic processes and disorders in lipid metabolism. The experimental findings indicate that irradiation with roentgen rays leads to disorders of metabolism in the heart muscle, which are expressed as inhibition of oxidative processes and disorders in active transport of substrates to the sarcoplasma. (auth)

29268 THE CONTENT OF PYRUVIC ACID AND LACTIC ACID IN BOVINE AND RABBIT LENS RELATIVE TO THE AMOUNT OF GLUCOSE IN THE NUTRIENT SOLUTION AND AFTER INJURY FROM X IRRADIATION. W. Paulus, O. Hockwin, and O. Kleifeld (Universitäts-Augenklinik, Bonn). Arch. Ophthalmol., 163: 324-7(1961). (In German)

Changes in vitro in the concentration of pyruvic and lactic acids in the lens of the calf, cattle, and rabbit were studied under various conditions. The lenses were incubated in a nutrient medium containing glucose in concentrations of 120, 300, or 600 mg/100 ml, with osmotic equilibrium being kept constant. In some experiments the lenses were irradiated in vitro with 100-kr doses of x rays, with the glucose concentration of the medium at 120 mg/100 ml. Irradiation did not significantly alter the pyruvic or lactic acid content of lens. Content of these acids was altered only in the experiments using 600-mg% concentrations of glucose in the medium. After 1.5 hr in this solution the pyruvate content of calf and rabbit lens fell 50% and in cattle lens 30%, while the lactate content of the lenses rose about 20%. Apparently raising the glucose content of lens promotes the conversion of pyruvate to lactate, at the same time stimulating the anaerobic oxidation of glucose. Free glucose in lens was increased when the lens was immersed in the 600-mg% glucose solution. Similar results have been reported for these metabolic changes in corneal epithelium. (BBB)

29269 OXYGEN UPTAKE OF THE SKIN AFTER X IRRADIATION. Lilli Kihn (Weserberglandklinik, Hoexter, Ger.). Arch. Physik. Therapie, 14: 343-6(July-Aug. 1962). (In German)

The in vivo exogenous oxygen uptake of human skin was determined before and after radiation therapy (both uv and x-ray) by a galvanometric method employing dropping Hg electrodes attached to the forearm and thigh skin. After uv irradiation a delay of the O_2 uptake in the latent period before erythema and an acceleration of the O_2 uptake during development of the erythema were seen. During a typical response (sunburn), histologically identical with a first degree burn, the skin temperature was markedly elevated and the O_2 uptake is delayed. Cellular respiratory function of the epidermis is evidently depressed by this degree of erythema. After x irradiation (800 r at 50-kv and short source-skin distances) an acceleration of O_2 uptake occurred immediately postirradiation. Also, to a smaller extent, this increased uptake occurred on the unirradiated contralateral extremity. In addition, an increase in the rate of the O_2 uptake was observed later during the erythema responses. After uv, as well as after x irradiation the O_2 uptake changed in phases over a period of days or weeks, presumably mainly as the result of local events occurring in the epidermis. However, this might be the result of biological cycles, as it can be observed for other skin functions (insensible perspiration). Similar investigations of skin temperature indicate that, after uv as well as after x irradiation, first the epidermis and then the vascular system react to radiation-initiated stimuli of, as yet, unknown nature. (BBB)

29270 EFFECT OF IMMUNOSUPPRESSIVE AGENTS ON ADJUVANT-INDUCED POLYARTHRITIS OF RATS. J. R. Ward, S. Cloud, E. Krawitt, and R. S. Jones (Univ. of Utah, Salt Lake City). Arthritis Rheumat., 6: 796-7(Dec. 1963).

One hypothesis for the pathogenesis of rat polyarthritis induced by injection of Freund-type adjuvants is hypersensitivity to disseminated microbacteria or their products. Therefore, the ability of immuno-suppressive agents (6-mercaptopurine, methotrexate, nitrogen mustard, total-body x irradiation) to alter the polyarthritis and/or tuberculin hypersensitivity was studied. Of 30 rats given only adjuvant, 90% developed disseminated arthritis and delayed skin reactions to the intradermal injection of old tuberculin. When 6-mercaptopurine was given to animals for 14 days, starting on the day of adjuvant injection, arthritis was strikingly suppressed but tuberculin hypersensitivity was not altered. Methotrexate, given for 8 to 14 days, was less effective in suppressing polyarthritis. Nitrogen mustard and total-body irradiation at near LD_{50} doses did not appreciably alter the incidence or severity of polyarthritis.

These studies suggest that hypersensitivity to tuberculoprotein has no significant pathogenetic role in adjuvant-induced polyarthritis of rats. (BBB)

29271 STUDIES ON THE STERILITY INDUCED BY UV RADIATION IN MALES OF DROSOPHILA MELANOGASTER WITH THE TECHNIQUES OF REUSS. B. Nicoletti, A. Olivieri, and G. Olivieri (Università, Rome). Atti Assoc. Genet. Ital., 9: 160-8(1964). (In Italian)

Experiments showed that uv-induced sterility in Drosophila melanogaster adult males must be mainly ascribed to physiological effects and not to genetical or cytological ones, as in the case of the x rays. Mutagenic doses of uv rays had no effects on the in vitro motility of the spermatozoa derived from the treated males. The same doses did not produce a decrease in the amount of progeny yielded by the irradiated fertile males. This led to the conclusion that the principal cause of sterility is not the uv-production of dominant lethals. The high sterility induced in the irradiated males is considered, on the contrary, to be due to physiological processes impairing the ability to mate. It was found that the initially sterile males do not later recover fertility. (auth)

29272 FURTHER DATA ON THE INTERACTION BETWEEN ULTRAVIOLET AND IONIZING RADIATIONS ON THE PRODUCTION OF RECESSIVE LETHALS IN DROSOPHILA MELANOGASTER. B. Nicoletti, A. Olivieri, and G. Olivieri (Università, Rome). Atti Assoc. Genet. Ital., 9: 172-84(1964). (In Italian)

The sex-linked recessive lethal mutation frequency induced by 4000 r of x rays in mature sperms of D. melanogaster was significantly decreased by a uv post-treatment (λ 2537 Å, 3×10^6 ergs/cm^2 exposure dose). Use of smaller uv doses (1.8×10 ergs/cm^2) did not result in a decrease of the x-ray induced recessive lethals. Spermatozoa and spermatids showed a similar sensitivity to uv induction of point mutation recessive lethals in a $X^{C2}yB$ ring chromosome. The possible mechanism through which uv radiation determines these effects was examined. (auth)

29273 PHENOBARBITONE ENZYME INDUCING EFFECT AND THE ACTION OF METHYSERGIDE ON THE BARBITURATE SLEEPING TIME IN GAMMA-IRRADIATED RATS. V. Varagic, S. Stepanovic, and S. Hajdukovic (Inst. for Nuclear Sciences "Boris Kidrich," Vincha, Yugoslavia and Dept. of Pharmacology, Medical Faculty, Belgrade). Biochem. Pharmacol., 13: 691-6(May 1964).

Both phenobarbitone and methysergide produce a decrease of the thialbarbitone sleeping time in gamma-irradiated rats. Phenobarbitone was injected 2 and 48 hr after irradiation with 600 r and 800 r. The effect of phenobarbitone was found to be maximal 48 hr after its injection, and it was evident only in rats irradiated with 600 r. Methysergide was also injected 2 and 48 hr after irradiation and this procedure was found not to affect the thialbarbitone sleeping time. On the contrary, methysergide significantly depressed the thialbarbitone sleeping time if injected 15 to 30 min before thialbarbitone. This effect of methysergide is present only in irradiated animals. Ethionine, if injected 15 min before methysergide, inhibited the action of methysergide on the thialbarbitone sleeping time. This effect of ethionine was not blocked by methionine. It is suggested that phenobarbitone and methysergide affect the thialbarbitone sleeping time either by different mechanisms, or by similar mechanisms in which time factor is different. (auth)

29274 STIMULATION OF THYROIDAL RADIOIODINE UPTAKE BY ACTINOMYCIN AND FLUOROURACIL. J. E. Dumont, F. R. Rodesch, and P. Rocmans (Center of Nuclear Medicine, Brussels). Biochem. Pharmacol., 13: 935-7(June 1964).

Actinomycin, fluorouracil, and thyrotropic hormone markedly stimulated the thyroidal uptake of ^{131}I in mice when administered 12 hr before ^{131}I administration. When injected 2 hr before ^{131}I, thyrotropic hormone stimulated the thyroidal uptake markedly, but the effect of fluorouracil was lowered and the effect of actinomycin was not apparent. Puromycin depressed the thyroidal uptake of ^{131}I. Possible reaction mechanisms involved are discussed. (C.H.)

29275 STRUCTURAL CHANGES OF GLIADIN PRODUCED BY GAMMA RADIATION OF WHEAT GRAINS. M. S. Reznichenko, E. E. Rydalevskii, and E. S. Gankina (Kirov Textile Inst., Leningrad). Biochemistry (USSR) (English Transl.), 28: 40-3(Jan.-Feb. 1963). Translated from Biokhimiya, 28: 52-6(Jan.-Feb. 1963).

N-terminal amino acids of gliadin isolated from wheat included aspartic and glutamic acids, serine, threonine, lysine, phenylalanine, and leucine. Quantitative determination of glutamic, aspartic acids, and serine showed a considerable decrease in their content on irradiating the protein as compared to the control. The decreased amount of N-terminal amino acids was proportional to the degree of irradiation. In gliadin isolated from grains irradiated in a state of increased moisture, a marked lowering of the molecular weight compared to gliadin isolated from grains irradiated in the dry state was observed. (auth)

29276 ELECTROPHORETIC AND IMMUNOCHEMICAL ANALYSIS OF BLOOD SERUM OF MICE IRRADIATED WITH A LETHAL DOSE OF X-RAYS. K. P. Kashkin, P. N. Grabar, and J. Courcon (Pasteur Inst., Paris). Biochemistry (USSR) (English Transl.), 28: 68-76(Jan.-Feb. 1963). Translated from Biokhimiya, 28: 89-100(Jan.-Feb. 1963).

Whole-body irradiation of mice with a lethal dose of x rays as a rule lowers the concentration of some normal serum proteins and sometimes causes the complete disappearance of some of these fractions. The increase in the concentration of α_2-globulins described in the literature after irradiation of animals is due to the appearance of new antigens in this zone. The increase in the concentration of proteins with the mobility of β_2-globulins on the other hand, is due to an increase in the β_2-I fraction associated with a decrease in the concentration of the other components of the β_2-globulins and migration of the β_2-I-globulin into this mobility zone. This more mobile component of the β_2-I-globulins appears only in the sera of irradiated animals and is absent from healthy mice. (auth)

29277 THE EFFECT OF ACUTE IRRADIATION OF BALSAM SEEDS (IMPATIENS BALSAMINA L.) ON THE FORMATION OF ANTHOCYANINS IN BLOSSOMS. Eva Klozova (Inst. of Experimental Botany, Czechoslovak Academy of Sciences, Prague). Biol. Plant. Acad. Sci. Bohemoslov., 4: 246-54(1962).

To investigate the indirect influence of irradiation on the production of anthocyanins in the blossoms of red balsam, after 18-hr germination the seeds were irradiated with 4560 r and changes in the anthocyanin content of blossoms examined. In X_0, three out of four lines of red balsam tested displayed a marked increase in anthocyanin content (18%, 18%, and 29%). In X_1 the quantitative content of anthocyanins either equalled that of the controls or was lower, while in X_2 a significant decrease in anthocyanin content in all the lines was observed. The question of whether the appearance of pink-flowering plants in the X_0

involves the heterozygous character of the material or whether this qualitative change can be considered as a consequence of irradiation is discussed. It is presumed that the occurrence of the pink flowers in the X_1 generation was a consequence of irradiation in the X_0 generation when a somatic recessive mutation took place which appeared phenotypically in the X_1 generation as a result of monohybrid segregation. It is suggested that the induced physiologic change in the quantitative content of anthocyanins, fading out during subsequent generations and apparently belonging to the so-called prolonged modifications, is a borderline physiologic-genetic phenomena. (BBB)

29278 TRYPTOPHAN CONTENT OF THE CELLULAR ELEMENTS OF THE INTESTINE OF RATS AND GUINEA PIGS AFTER WHOLE-BODY X IRRADIATION. P. M. Ansari, H. Eder, and W. Naegele (Battelle-Institut, Frankfurt am Main). Blut, 9: 292-6(Aug. 1963). (In German)

Whole-body x irradiation of the guinea pig causes the temporary disappearance of the enterochromaffin cells of the intestinal wall. These cells produce 5-hydroxytryptamine (serotonin) which is formed from the precursor tryptophan. Experiments were conducted to determine whether the normal tryptophan content and distribution in guinea pig and rat intestine are influenced by tryptophan feeding or whole-body irradiation, by the use of histochemical methods. With a technique employing nitrous acid and dimethylaminobenzaldehyde it was possible to detect tryptophan-containing cells (eosinophilic leucocytes) in the intestinal wall of both species. Oral administration of a single dose of 1 g DL-tryptophan per kg body wt had no effect on the intensity of the histochemical reaction of these cells, and presumably on their tryptophan content. Three hr after 600-r, whole-body x irradiation these eosinophils migrated into the stroma of the Lieberkuehn crypts, and this was accompanied by a loss of some of their tryptophan-bearing granules. At this time, numerous liberated granules could be seen around the crypt cells. After 24 hr the eosinophils were present only in the crypts and villi. Some loss of granules from Paneth cells was observed; these cells are apparently relatively radioresistant. The migration of the eosinophilic granulocytes into the crypts and their loss of tryptophan-containing granules there suggests the possibility that the tryptophan which these cells liberate may be used by the enterochromaffin cells in the crypts to synthesize serotonin. (BBB)

29279 IRRADIATION IN VITRO OF TISSUE THROMBOPLASTIN. G. Caprino, G. Cittadini, and L. Maccioni (Universita, Siena, Italy). Boll. Soc. Ital. Biol. Sper., 38: 1324-5(Dec. 31, 1962). (In Italian)

Whether ionizing radiation acts directly on thromboplastin or acts on other factors blocking its formation was investigated. Tissue thromboplastin obtained from rabbit brain, which contains all the factors of blood thromboplastin except factors V, VII, and X, was irradiated in vitro in solution using 0.1 g thromboplastin per 0.3 ml solution. Two samples were used as controls and eight were subjected to doses progressively doubled from 4000 to 512,000 r. The time of irradiation ranged from 2 min to 4 hr; at room temperature tissue thromboplastin cannot be preserved more than several hours. The activity of the samples was determined by thrombodensitography, using the coagulation of mixtures of thromboplastin and normal plasma, obtained by heart puncture from rabbits. After irradiation, tissue thromboplastin showed the same activity as normal rabbit plasma; prolonged irradiation did not change the rate of increase of the extinction nor the period of maximum rate of increase (45th to 90th sec). It is concluded that hypocoagulability after total irradiation cannot be attributed to direct action of radiation on the thromboplastin complex, but must be due to a change in its formation. (BBB)

29280 THE COAGULATION OF BLOOD IRRADIATED IN VITRO. G. Caprino, G. Cittadini, and L. Maccioni (Università, Siena, Italy). Boll. Soc. Ital. Biol. Sper., 38: 1326-8(Dec. 31, 1962). (In Italian)

29281 EFFECTS OF FASTING AND IRRADIATION ON BLOOD POLYSACCHARIDE PHOSPHORYLASE ACTIVITY IN RATS. D. Bonsignore, C. Canonica, O. Sartori, and L. Lenzerini (C.A.M.E.N., Pisa, Italy). Boll. Soc. Ital. Biol. Sper., 39: 1664-7(Dec. 31, 1963). (In Italian)

Effects of irradiation (700 r) and starvation on polysaccharide phosphorylase activity were studied in liver homogenates of adult white rats. Enzyme activity, increased in starved animals by 108 to 117% over the controls, was lowered by irradiation to 42 to 58% greater than normally fed rats. Results are in agreement with radioinduced blood glycogen changes noted by other workers. It is suggested that radioinduced enzyme activity be compared with nonspecific effects of alimentation. (TCO)

29282 STUDIES ON PERCUTANEOUS ABSORPTION FOLLOWING ROENTGEN IRRADIATION. Gyula Kiss and Ágnes Haug (Orvostudományi Egyetem, Belgyógyászati Klinika, Pécs, Hungary). Borgyogyaszati Venerol. Szemle, 38: 74-7(Apr. 1962). (In Hungarian)

Attempts were made to determine the least amount of irradiation that is necessary to cause permanent change in the polarization resistance of the skin, that is, an irreversible decrease in percutaneous absorption. Measurements were made on normal skin as well as skin irradiated with 800-, 1000-, and 1200-r doses of 60-kv x rays. The polarization percentage was determined by an electropermeograph on the irradiated as well as on the surrounding healthy skin surface. Results showed that during the erythematous phase following irradiation the percentage of polarization, as an indicator of ion permeability, decreased markedly; thus the decrease of polarization percentage reflects an increase in skin permeability to ions. These measurements showed a marked increase in the ion permeability of the skin after 1000- and 1200-r x irradiation, and the increase could also be noted at 800-r doses. Measurement of polarization at two, three, and 6 months postirradiation still showed values above normal; however, the measurement taken 6 months postirradiation after 800 r showed no significant increase. The same 800-, 1000-, and 1200-r total doses when given in 200-r daily doses did not cause lasting changes in the polarization values. It is concluded that irradiation doses of 1000 to 1200 r, when administered in a single dose, will cause permanent injury to the skin, whereas mild erythema from fractional doses is not followed by permanent damage to skin tissue. (BBB)

29283 THE EFFECT OF ^{60}Co IRRADIATION ON BRAIN TUMOR CULTURES IN VITRO. G. Mungyerova, I. Kuzma, and K. Jacz (Inst. of Experimental Medicine, Bratislava). Bratislav. Lekarske Listy, 43: 419-26 (1963). (In Czech.)

The comparative radiosensitivity of different types of brain tumors to ^{60}Co γ radiation and 180-kv x rays was studied using explants of 11 neurogenic human neoplasms (four multiform glioblastomas, one medulloblastoma, one spongioblastoma, one ependymoblastoma, one ependymoma, one neurinoma, and two meningiomas). Over 1800 explants were made and irradiated with 8000 r doses of γ or x rays. Regressive changes in the cells were studied

in stained cultures and by phase-contrast microscopy. The ^{60}Co γ-ray dose of 8000 r was shown to produce degeneration and decay of cells in glioblastoma multiforme and medulloblastoma, whereas cultures of ependymoma, ependymoblastoma, spongioblastoma, neurinoma, and meningiomas remained practically unaltered following irradiation. Similar experiments with x irradiation suggested that the biologic action of both the types of radiation is the same. These results suggest that postoperative radiotherapy in the dose range generally used (6000 to 8000 r) is not very effective against some radioresistant tumors of the central nervous system. (BBB)

29284 INFLUENCE OF A SINGLE DOSE OF X RAYS ON THE DEVELOPMENT OF FRIEND'S DISEASE. J. F. Duplan and C. Levy (Institut du Radium, Paris). Bull. Assoc. Franc. Etude Cancer, 49: 390-8(Oct.-Dec. 1962). (In French)

The effects of whole-body irradiation as well as localized irradiation of the spleen on the histologic and hematologic evolution of Friend's disease was investigated. A group of nonconsanguineous 10-day-old mice was infected by intraperitoneal administration of 0.2 ml of a virus extract prepared from mice spleens, virus-inoculated 40 to 60 days previously. At age 40 days, 30 days postinoculation, test animals were exposed to 300-r x irradiation. A second group of mice was first irradiated with 300 r and then inoculated 3, 6, or 14 days postirradiation. The results demonstrated that irradiation of inoculated mice extended survival time without changing the morbidity or mortality of the disease which remained at 100%. Irradiation prior to inoculation had this same effect only in the case of the mice irradiated three days before inoculation. It was concluded that at this radiation dose Friend's cells as well as other cells acting as a target for the virus demonstrate low radiosensitivity, and that if whole-body is more effective than localized splenic irradiation at the same dosage, it is not due to a direct damaging action but probably because x rays retard virus multiplication through alteration of the general state of the animal. (BBB)

29285 SURVIVAL OF FUNGI IN SOIL EXPOSED TO GAMMA RADIATION. Leander F. Johnson (Univ. of Tennessee, Knoxville) and T. S. Osborne. Can. J. Botany, 42: 105-13(Jan. 1964).

A study was undertaken: to investigate the influence of γ radiation on the natural fungal population of an agricultural soil, to determine relative survival of species of fungi in soil exposed to different doses of radiation, and to study the viability and subsequent growth of selected species of soil fungi in pure culture under chronic irradiation. Samples of soil (Etowah silt loam) were exposed to radiation from a ^{60}Co source. By a modified soil-plate technique, fungi were isolated from the radiation-treated soils and compared to those isolated from untreated soils. At intensities of 250, 500, 750, and 1000 kr, 2.53, 0.67, 0.10, and 0.04%, respectively, of the viable propagules of fungi survived. Twenty-eight species of fungi survived soil irradiation of 250 kr or more, many of which were not isolated from untreated soil; hence, prior irradiation of soil samples enables isolation of certain fungi that occur in soils in low numbers and not ordinarily found on conventional dilution or soil plates. Most of the members of the Moniliaceae, comprising a large portion of the soil fungal population, were killed by radiation, but the Dematiaceae generally were more resistant. It was found that resistance of certain fungal spores in soil to high intensity radiation is related to growth rates of mycelium in pure culture under sublethal levels of continuous radiation. The mycelium of three resistant fungi, which originally survived high doses of radiation, grew better under chronic irradiation than did two susceptible fungi, which were killed by high doses of soil irradiation. There is only very little evidence of cumulative effects of growth inhibition under chronic irradiation of cultures, since slopes of the growth curves did not drop appreciably during exposure periods. (BBB)

29286 POSTIRRADIATION PROTEIN SYNTHESIS AND THE INDUCTIONS OF CYTOPLASMIC AND GENIC MUTATIONS IN SACCHAROMYCES BY ULTRAVIOLET RADIATION. Alvin Sarachek and John T. Bish (Univ. of Wichita, Kan.). Cytologia (Tokyo), 28: 450-62(Dec. 1963).

In the yeast Saccharomyces, gene mutations are induced by uv in the same low order of frequency observed in other organisms, but cytoplasmic mutations to respiratory deficiency occur in a large percentage of the individuals surviving irradiation. To obtain more specific information on the relation of protein synthesis to different kinds of genetic damage, a study was undertaken of the extent to which the establishments of these two distinctive catagories of mutation in yeast respond to conditions affecting postirradiation protein synthesis. Protein synthesis was examined after uv-induced cytoplasmically inherited respiratory deficiency and genic reversions from adenine auxotrophy to prototrophy in Saccharomyces 13778R. Conditions affecting protein synthesis were modified by varying the nutritional status of cells before and after irradiation and by use of the phenylalanine analogue, p-fluorophenylalanine. Circumstances favoring protein synthesis during the first half of the first postirradiation cell division were found essential for the induction of a maximal number of genic mutants. Previous investigators have reported similar findings with bacteria and Neurospora. Postirradiation protein synthesis did not affect the frequency with which cytoplasmic mutants were induced. These results provide additional support for the proposition that uv-induced gene mutation is an indirect process requiring the translation of primary radiation damage into the genetic apparatus through processes involving protein synthesis. They also suggest that cytoplasmically inherited respiratory deficiency may be induced by a direct derangement by uv of the structural integrity of the mitochondrion. (BBB)

29287 ON SOME EFFECTS OF IONIZING RADIATIONS UPON DEVELOPING POLYOVULATED MOUSE EGGS. Akiko Sato (Hokkaido Univ., Sapporo). Embryologia (Nagoya), 7: 320-30(Feb. 1963).

A study was made of the effects of x radiation on developing mouse eggs, polyovulated by hormones, with special regard to abnormalities in embryos and newborn in relation to the radioprotective effect of the endocrine treatments. Female mice at various stages of the estrus cycle were injected with 5 IU pregnant mares' serum (PMS), then were given an injection of 5 IU human chorionic gonadotrophic (HCG) 44 hours later, on the day of mating. Ovulation was found to occur 12 to 16 hr after injection of HCG. Those females which had mated were subjected to single exposure of total-body x irradiation about 12 hr after expected ovulation. Five dose levels were used: 10, 25, 50, 100, and 200 r. The irradiation dose of 25 r was significantly effective in inducing pregnancy, resulting in a frequency of 67.9% compared with a control frequency of 16.8%, while 10 r was not effective and 200 r was injurious. The average number of implants with normal appearance slightly increased after low level irradiation, but did not noticeably differ by dosages. The mean litter size slightly decreased in the irradiated groups. The number of

externally normal developing eggs was nearly the same in both control and experimental groups following 25 r irradiation. It was concluded that 25 r x irradiation is favorable for facilitating the implantation of hormonally polyovulated eggs. Apparently this low level irradiation did not affect the developing eggs, since no morphologic changes were found in the embryos in the course of gestation. It is suggested that 25-r irradiation does not exert any influence on the developing egg itself, but affects the function or nature of the uterus leading to more favorable conditions for implantation. Speculation is offered that low level irradiation affects, to some extent, the endocrine systems of the uterus treated with gonadotrophin, and facilitates the implantation of ova. (BBB)

29288 IN VITRO AND IN VIVO EFFECTS OF X-RAYS AND OF IODOACETIC ACID ON P^{32} INCORPORATION INTO PHOSPHOETHANOLAMINE OF RAT THYMUS CELLS. P. Misti Dorello, M. Boccacci, and M. Quintiliani (Istituto Superiore di Sanita, Rome). Experientia, 20: 299-300(1964).

The effects of x rays and iodoacetic acid on the incorporation of ^{32}P-labeled orthophosphate in rat thymocytes in vivo and in vitro were studied. Results of in vitro experiments showed that x rays as well as iodoacetic acid significantly inhibit the incorporation of ^{32}P into phosphoethanolamine (PEA) whereas the amount of PEA in the aliquot of cell extract remained unchanged. In in vivo experiments a whole-body irradiation with 1000 r induced a significant inhibition of ^{32}P incorporation into thymus PEA. This inhibition increased with time up to 8 hr after irradiation. (M.C.G.)

29289 LONG-LASTING CHANGES IN CELL PERMEABILITY INDUCED BY X-RAY RADIATION. V. Srb (Charles Univ., Hradec Kralove, Czechoslovakia). Exptl. Cell Res., 34: 318-24(Apr. 1964). (In German)

X radiation (1000 r) induced changes in cell permeability in the inner epidermis of the third coat of anions for an electrolyte, KNO_3, and a non-electrolyte, sucrose. Changes in cell permeability induced by radiation varied on 40 days during the experiment. It was concluded that radioinduced changes in cell membrane permeability are of a lasting character and sometimes can be irreversible. (C.H.)

29290 PRENATAL CHRONIC GAMMA IRRADIATION AND AUDIOGENIC SEIZURES IN RATS. Julian P. Cooke, Sidney O. Brown, and George M. Krise (Texas A. & M. Univ., College Station). Exptl. Neurol., 9: 243-8(Mar. 1964).

Pregnant female Wistar rats in a ^{60}Co irradiation chamber received 20 r delivered at the chronic rate of 2 r per day (23 hr/24-hr day) for the first 10 days of gestation. When all F_2 offspring were 45 days of age, the 49 controls and 61 prenatally irradiated rats were tested for seizure with frequencies of 5000 to 8000 cycle/sec superimposed upon frequencies of 8000 to 11,000 cycle/sec and oscillated at 120 times per min at a mean sound level of 122 db. Each animal was tested four times, when 46, 48, 50, and 52 days of age. The results revealed a significant decrease in the incidence of the run-only seizure reactions and an increase in the full (tetany) seizure in female rats. When both sexes were considered as one group, a significant increase of the full seizure took place. No obvious cause of changes in the incidence of seizure following γ irradiation was evident. Data indicate that irradiation of this strain of female Wistar rat during the period of prenatal development predisposes her to display the same susceptibility to seizure as either the irradiated or nonirradiated male. The threshold dose for this increased sensitivity is estimated to be below 20 r. It is suggested that this reaction in the female Wistar rat may be used as the basis of a technique that may serve as a biological indicator of low-level radiation and for investigation of stress reactions. (BBB)

29291 THE METABOLIC KINETICS OF GLUCOSE IN GAMMA-IRRADIATED RATS, STUDIED BY A NEW TECHNIQUE OF CONTINUOUS INFUSION OF LABELED GLUCOSE. R. Masironi (Università, Rome). Farmaco (Pavia), Ed. Sci., 17: 3-10(Jan. 1962). (In Italian)

Glucose pool size, glucose pool space, turnover rate, turnover time, and oxidation rate were determined in irradiated rats maintained without food. Glucose-^{14}C was infused to obtain steady state through the left carotid artery and the right jugular vein by means of polyethylene cannulae. After 24-hr fasting the rats were subjected to 820 r total γ irradiation (^{60}Co), and the fast was maintained to the end of the experiment. Plasma glucose in controls dropped from 107 mg/100 ml plasma at 6 hr to 90 at 24 hr, then rose to 122 at 48 hr after irradiation; in irradiated rats the value rose from 110 at 6 hr to 122 at 12 hr and remained constant. Liver glycogen in controls rose only after 36 hr; in irradiated animals this value (mg glucose/100 g liver) was 500 at 6 to 12 hr, and 1000, 900, 800, at 24, 36, and 48 hr respectively. The activity of CO_2 expired was about 900 cpm/mg C from 120 to 180 min for both sets of animals, with the irradiated animals slightly higher. The concentration of plasma glucose during continuous infusion remained at 90 for controls and 125 for irradiated animals; the sp act. was constant for the same period (180 min), about 7000 for controls and 6000 for irradiated animals. The calculated means for the following data were obtained for controls and irradiated animals respectively: liver glycogen, 74.0, 897.1 mg glucose/100 g liver; turnover time, 72.1, 75.0 min; glucose pool size, 38.9, 44.7 mg C or 12.5, 14.5 mg C/100 g body weight, glucose space, 33.9, 28.9% body weight; turnover rate, 0.54, 0.59 or 0.25, 0.31 mg C/min, oxidation rate, 0.0080, 0.0099 mg C x body weight$^{0.6}$/min; oxidation rate/turnover rate, 0.38, 0.38. (BBB)

29292 GENETIC ANALYSIS OF THE STRUCTURE OF THE ad-3 REGION OF NEUROSPORA CRASSA BY MEANS OF IRREPARABLE RECESSIVE LETHAL MUTATIONS. F. J. de Serres (Oak Ridge National Lab., Tenn.). Genetics, 50: 21-30(July 1964).

Homology testing of 23 x-ray-induced irreparable and reparable recessive lethal mutations of Neurospora crassa (induced and maintained in a balanced heterokaryon) showed that the ad-3A and ad-3B loci are separated by a genetic region, designated region X, containing an unspecified number of loci of unknown function. These data also suggest that the irreparable recessive lethal ad-3 mutations are extragenic mutations resulting from such events as chromosome deletion, whereas the reparable ad-3 mutations are intragenic mutations and have genetic damage confined to sites within the ad-3A or ad-3B locus. (auth)

29293 STUDIES ON THE FREQUENCIES OF CHROMATID ABERRATIONS INDUCED BY X RAYS AT DIFFERENT TIMES OF THE CELL CYCLE OF VICIA FABA. J. Grant Brewen (Oak Ridge National Lab., Tenn.). Genetics, 50: 101-7(July 1964).

Cells of Vicia faba lateral root tips were mitotically synchronized and irradiated with 25 r of x rays at various times during the cell cycle. The stage of the cell cycle in which the cells were at the time of irradiation was determined by their ability to incorporate tritiated thymidine into their chromosomes. It was found that as the cells go from the period of DNA synthesis (S) to the post-DNA syn-

thesis period (G_2) the number of aberrations induced increases by a factor greater than two. This increase is a result of an increase in only two-break aberrations, the frequency of one-break aberrations remaining constant from S through G_2. It is concluded from these data that the increase in aberration yield as the cells go from S to G_2 is the result of an increase in the number of sites within which an exchange can occur, and not of an increase of the sensitivity of the chromosome strands to x rays. In very late G_2 or early prophase a sudden decrease in aberration yield occurs. This is interpreted as a decrease in the number of sites and also a possible decrease in the sensitivity of the chromosome strand to x rays, since both one- and two-break aberrations decrease in frequency. (auth)

29294 ACTION OF A SUPER-SUPPRESSOR IN YEAST IN RELATION TO ALLELIC MAPPING AND COMPLEMENTATION. Thomas R. Manney (Univ. of California, Berkeley). Genetics, 50: 109-21(July 1964).

The tryptophan synthetase system of Saccharomyces cerevisiae was investigated and used to study the action of a super-suppressor. Thirty-six allelic tr_5 mutants were characterized. All accumulated indoleglycerol phosphate when grown on tryptophan-limited medium. Three also accumulated indole. One was able to utilize indole in place of tryptophan. Of 35 mutants tested in all possible combinations in diploids, 19 complemented with at least one other. A linear complementation map was constructed from these results. A map of 29 mutants was constructed by the x-ray method. The mutants are randomly distributed along the length of this map with the exception of four that are repeats at the same site. This map is colinear with the complementation map with one exception. Thirteen of 32 mutants tested were suppressed by the super-suppressor S_d. Of these, only two are of the complementing type. One mutant is altered by S_d to an indole-utilizing phenotype. This mutant has unusual reversion properties. The two mutants that are both suppressible and complementing are unique in that they complement only with alleles that are to their right on the x-ray map. The results are consistent with the model of super-suppressible mutants being nonsense mutants. (auth)

29295 GENETIC LOADS IN IRRADIATED EXPERIMENTAL POPULATIONS OF DROSOPHILA MELANOGASTER. K. Sankaranarayanan (Columbia Univ., New York). Genetics, 50: 131-50(July 1964).

The influence of x-radiation-induced genetic loads on the viability of experimental populations of Drosophila melanogaster maintained under relatively relaxed selection conditions was studied. Four dose levels (2000 r, 4000 r, 6000 r and 7000 r) were used and only the males were irradiated. Three populations received radiation in every generation; subpopulations were derived from these after 1, 5, 10, 15, 20, and 25 generations and propagated without further irradiation. The components of viability investigated were hatchability of the eggs, larva-adult survival, and egg-adult survival. In the chronically irradiated populations, viability decreased for the first few generations and then fluctuated about an equilibrium level depending on the amount and the history of the irradiation. The subpopulations derived from the irradiated ones manifested a rapid recovery to almost the control levels of viability in three to seven generations. The preliminary data on chromosome analysis indicate that, under the influence of induced mutation pressure, the populations tend to accumulate recessive lethals and semilethals. The mean viability of the homozygotes for the quasi-normal chromosomes is below that of the heterozygotes. (auth)

29296 EVIDENCE FOR DIFFERENTIAL RADIOSENSITIVITY RATHER THAN RECOVERY IN SPERM SAMPLES FROM X-IRRADIATED DROSOPHILA MELANOGASTER MALES. H. Traut (Kernforschungszentrum, Karlsruhe, Ger.). Genetics, 50: 167-71(July 1964).

Sperm released the first day after the x irradiation of 3 to 4 day old males of Drosophila melanogaster showed a higher mutation frequency than the second day sperm. From a comparison of mutation frequencies of successive one day broods from males which were mated immediately after irradiation with those from males which had been stored for one day before they were mated, it seems likely that the difference between the mutation frequencies of the first and second day is caused by a relatively low initial radiosensitivity of the second day sperm rather than by recovery from radiation damage of the first day sperm owing to the one day storage period. (auth)

29297 DIFFERENTIAL RADIOSENSITIVITY AS AN EXPLANATION FOR SO-CALLED RECOVERY IN DROSOPHILA SPERM. W. E. Trout (Indiana Univ., Bloomington). Genetics, 50: 173-9(July 1964).

A decline in the sex-linked lethal mutation frequency from the first to the second day after x irradiation was observed with rod- and ring-X chromosomes of Drosophila melanogaster when males, irradiated three to four days after eclosion, were mated singly to females at either half-day or daily intervals. A rise in frequency was observed, however, if males had been exhaustively mated for eight days after eclosion and were then irradiated. In all cases an intermediate mutation frequency was observed if males were not allowed to mate on the first day. On the other hand, the frequency for the second day for males which on the first day were given the opportunity to mate, but failed to do so effectively, was even lower than the second day frequency for males that mated on the first day. All these results support the concept of a differential sensitivity to x rays associated with position in the genital tract, and mixing of sperm if matings are delayed, rather than a recovery process. (auth)

29298 EVALUATION OF PLUTONIUM EXPOSURES IN MAN. J. S. Robertson and S. H. Cohn (Brookhaven National Lab., Upton, N. Y.). Health Phys., 10: 373-89(June 1964). (BNL-7041; BNL-7041(Rev.))

The radiation hazard from plutonium in occupationally-exposed personnel is reviewed. Although these people are exposed to plutonium most typically by inhalation, the only experimental kinetic studies conducted with human beings as the subjects involved the intravenous administration of plutonium. Kinetic data from animal studies indicate that when plutonium enters the body by inhalation it tends to be retained in the lungs for prolonged periods of time, being removed from the lungs with a half-time of the order of 300 days. The plutonium in the lungs thus acts as a continuous source of plutonium entering the circulation. It is suggested that the plutonium from the lungs introduces a significant error in those estimations of the plutonium body burden that are calculated from plutonium urinary excretion data using formulas derived from the injection experiments, and which at least tacitly assume that, after an initial period, the urinary plutonium reflects bone and liver plutonium concentrations. The animal studies suggest that it may be feasible to evaluate the lung burden more directly by external counting methods and through the use of plutonium fecal excretion data. The animal plutonium-239 toxicity data are also reassessed in regard to the maximum permissible body burden of plutonium, and no change in the currently accepted value of 0.04 μc ^{239}Pu

is considered to be indicated on the basis of the available data. (auth)

29299 SKELETAL DISTRIBUTION OF Ra^{226} IN SWINE CONSUMING FEED AND WATER WITH NATURALLY OCCURRING RADIUM. Neal S. Nelson and John H. Rust (Univ. of Chicago). Health Phys., 10: 407-13(June 1964).

Experimental data on the distribution of radium-226 in six mature swine are reported. Homologous bones from each animal were analyzed by a radon evolution method. Results were corrected to compensate for the effect of length of count on counting statistics. Non-uniformity of distribution of radium-226 in the skeleton was observed and possible explanations of the factors governing this non-uniformity were offered. The values obtained, 0.0118 to 0.0807 pc of radium-226 per g of ash, were normalized to allow for more useful comparisons. The body burden of radium-226 in a 102.0 kg standard pig was calculated as between 80 and 397 pc, based on collected data and published data on swine carcass composition. The skeletal calcium content of the 70 kg standard pig was as 1.25–1.60 kg of calcium compared with 1.00 kg in the 70 kg standard man. The effect of this relatively larger skeletal depot might have on the distribution of a body burden of radium-226 similar to that found in man is discussed. (auth)

29300 STUDIES OF IRRADIATED MOUSE POPULATIONS. II. DOMINANT EFFECTS ON PRODUCTIVITY IN THE 4th-6th GENERATION. K. G. Luning (Univ. of Stockholm). Hereditas, 50: 361-76(1963).

Previous results described the 1st generation of a population study in which the males of each generation received one acute x-ray dose (276 r) to the spermatogonia, also of controls of the same size, bred under the same conditions. These populations have now reached the 7th generation; to preserve recessive mutations the populations were propagated by random mating. Productivity data are presented for the 4th, 5th, and 6th generations, as compared with the control population. There is no detectable effect with regard to the number of dead or sterile during the test period of 170 days. There is a very slightly lower number of litters in the irradiation series, while the litter size shows a consistent reduction independent of the number of litters produced by the females. Slightly more litters are completely lost in the irradiation series than in the control. The sex ratio is not affected. The rate of death between birth and weaning in litters with at least one weaned depends upon the mother in such a way that females that have lost one or more litters completely had, in surviving litters, a higher death rate than females that kept all litters. Only in the former group is there a significant effect from irradiation while in the latter the difference is insignificant but both are in the direction of a higher death rate in the irradiation series. In this study only those effects were dealt with which are dominant and affect productivity. Consequently only part of the genetic effects was revealed. The data indicate that in this population dominant genes have accumulated which in various ways can affect the productivity as judged by the number of young weaned. A considerable part of the effects involves the mother rather than the young. (BBB)

29301 DELAYED ANTIBODY SYNTHESIS IN MICE AFTER TRANSFER OF IMMUNE PERITONEAL FLUID CELLS. E. Weiler (Inst. for Cancer Research, Philadelphia). Immunology, 7: 197-212(May 1964).

Ascites fluid, rich in bacteriophage-neutralizing antibody, was produced when mice were treated first with lethal or near-lethal whole-body x radiation; second, intravenous injection of spleen cells from donor mice immunized against bacteriophage; and third, intraperitoneal injection of bacteriophage in Freund's adjuvant. The immune ascites cells were washed and transferred to other mice without further addition of antigen. The highest rate of antibody synthesis occurred between the 5th and the 11th day after cell transfer. In contrast, spleen cells similarly transferred gave rise to antibody formation with the maximum rate of synthesis immediately after transfer. Antibody formation occurred essentially only in isologous recipients, not in homologous ones. The effects of physical stresses (freezing, thawing, and irradiation) on donor cell antibody stimulation were investigated. X irradiation (650 r) of the host prior to immune ascites cell transfer does not decrease the amounts of antibody produced afterwards, but rather leads to a significant increase. Control groups of irradiated mice that received bacteriophage antigen alone at the same time after irradiation when cell transfer was carried out in the other groups showed that the capacity of the host mice to respond to a primary antigen stimulus was practically abolished for the duration of the experiment, but high levels of antibody are produced when immune peritoneal cells are injected into newborn mice within 20 hr after birth. Conclusions derived from the experiments were: free antigen in immunogenic quantities is not present in the system and the information on antibody specificity and the stimulus for antibody production are properties of the cells themselves; the delayed antibody synthesis depends on the state of viability of the transferred cells. (BBB)

29302 ACTION OF RADIATION ON THE NERVOUS SYSTEM: AN ELECTROENCEPHALOGRAPHIC STUDY. E. Klimkova-Deutschova and B. Roth (Charles Univ., Prague). Intern. Arch. Gewerbepathol. Gewerbehyg., 20: 1-10(1963). (In German)

Electroencephalograms (EEG) were recorded in 46 persons who developed neurotic traits after prolonged exposure to electromagnetic radiations, ranging from x rays to radiations with wavelengths of several meters, usually on account of occupational exposure. The present symptoms included irritability, drowsiness, nervousness, headache, generalized weakness, and various other inhibition reactions. Disorders of the autonomic nervous system were prevalent and occasionally disturbances of the extrapyramidal, pyramidal, cerebellar, and vestibular functions were evident. Abnormal EEG tracings were obtained in ~ one-third; 10 persons showed only slight anomalies and in six the changes reflected more serious disturbances. Signs of diminished vigilance were seen in 59%, accompanied in six cases by other pathologic findings. The combined clinical and EEG findings suggested predominately the presence of inhibition processes; and the intensity of the EEG changes paralleled the severity of the clinical findings. The preponderance of sleep rhythms in the abnormal EEGs indicates mainly mesodiencephalic injury in these patients. The results indicate that the EEG is valuable for detecting excessive occupational radiation exposure of the central nervous system when combined with clinical data. (BBB)

29303 CERTAIN CONCLUSIONS AND PERSPECTIVES OF THE DEVELOPMENT OF RADIOBIOLOGICAL INVESTIGATIONS IN COSMOS. N. M. Sissakian, V. V. Parin, V. V. Antipov, N. N. Dobrov, and P. P. Saksonov. Izv. Akad. Nauk SSSR, Ser. Biol., No. 3, 341-51(May-June 1964). (In Russian)

Problems of radiobiological investigations in cosmic space are considered. The relative biological effectiveness of protons and heavy nuclei of different energy, the effect of these particles together with the other factors of the flight on the organism, and the pharmacological radiation protection are discussed in detail. The results of radiobiological investigations on seven Soviet space ships are given. The pathways of further investigations of the biological effect of cosmic radiation and elaboration of radiation protection of the cosmonaut and the whole biocomplex of the space ship are discussed. (auth)

29304 ISOLOGOUS INTERFERENCE WITH ULTRAVIOLET AND X-RAY IRRADIATED BACTERIOPHAGE T_2. Stuart B. Levy (Institut du Radium, Paris). J. Bacteriol., 87: 1330-8(June 1964).

Qualitative and quantitative analysis of the interference capacity of an irradiated T_2 bacteriophage was made with ultraviolet and x irradiation. Two different effects were found to explain the total interference picture in the ultraviolet-irradiated system: exclusion and depression. Exclusion is the absolute inhibition of infectious phage growth in the bacterial host. Depression is the diminution of burst size in instances where the infectious phage has not been excluded. Both effects were seen when the infectious phage was added after the addition of ultraviolet-irradiated phage. Doses between 1,600 and 2,200 ergs/mm^2 showed the greatest exclusion effect (70%). Exclusion was lost between 6,500 and 7,500 ergs/mm^2. The depression effect was highest (90%) at lower doses, falling off as the dose range went above 1,600 ergs/mm^2 or survivals of 10^{-7}. Depression was lost at 3,000 ergs/mm^2. X-ray irradiation (both direct and indirect) to survivals less than 10^{-2} showed no interference capacity in the phage irradiated. Indirect x irradiation to survivals between 5 and 10% showed 50% exclusion, but no depression. (auth)

29305 SYNTHESIS OF RIBONUCLEIC ACID BY X-IRRADIATED BACTERIA. E. W. Frampton (Univ. of Texas, Houston). J. Bacteriol., 87: 1369-76(June 1964).

Postirradiation synthesis of total ribonucleic acid (RNA) and of RNA components was measured after exposure of Escherichia coli B/r to x rays. Net synthesis of RNA measured by the orcinol reaction and by the incorporation of uridine-2-^{14}C was depressed in irradiated cells, but paralleled the period of postirradiation growth (30 to 40 min). Incorporation of uridine-2-^{14}C, added after net synthesis of RNA had ceased, detected an apparent turnover in a portion of the RNA. Irradiated cells retained their ability to adjust RNA synthesis to growth rate. After a shift-down in growth rate, irradiated cells incorporated radioactive uridine, while the net synthesis of RNA ceased, presumptive evidence for a continued synthesis of messenger RNA. Chloramphenicol addition (100 μg/ml) did not influence the total amount of RNA synthesized. Synthesis of ribosomes and transfer RNA preceded by 0, 5, 10, and 15 min of postirradiation incubation was observed by the resolution of cell-free extracts on sucrose density gradients. Little immediate influence of irradiation could be detected on the synthesis of 50S and 30S ribosomes. A decline was observed in the synthesis of 50S ribosomes with continued postirradiation incubation; 30S ribosomes, ribosomal precursors, and 4S RNA continued to be synthesized. (auth)

29306 REPRODUCTIVE SURVIVAL OF HeLa S3 X-IRRADIATED AT DIFFERENT STAGES ON THE DIVISION CYCLE. L. J. Tolmach (Washington Univ., St. Louis). J. Cellular Comp. Physiol., 62: 141-3(Oct. 1963).

A technique was developed for obtaining synchronized populations of HeLa S3 cells by taking advantage of the fact that mitotic cells are weakly attached to the surface of the culture vessel. The system was used to study x-ray sensitivity during the cell cycle. Results showed that mitotic cells are maximally sensitive with respect to loss of the capacity for sustained proliferation. Maximal interphase sensitivity in the G1 phase was definitely later than the time of inception of DNA synthesis. To increase resolution, DNA synthesis was blocked with two agents that act by different mechanisms, fluorodeoxyuridine and deoxyadenosine. In the presence of either of these inhibitors, no sensitivity decrease occurred at 10 hr; survival continued to decrease, and then reached a plateau (presumably when all the cells have completed G1) at a level as low as that for mitotic cells. Cells remained sensitive as long as DNA synthesis was inhibited. It is, therefore, possible to pinpoint the time of maximal sensitivity at the end of G1. There was a strong correlation between the drop in sensitivity and the synthesis of DNA; the former not occurring without the latter. It was concluded that DNA itself is a reasonable candidate for the target molecule whose damage by x rays is an important cause of cell death. (BBB)

29307 ROUND-TABLE DISCUSSION: DIFFERENTIAL SENSITIVITY OF THE CELL LIFE CYCLE. Hans Ris (Univ. of Wisconsin, Madison). J. Cellular Comp. Physiol., 62: 141-56(Oct. 1963).

The effects of ionizing and uv radiations, and various other inhibitors of protein and nucleic acid synthesis, on mitosis and DNA replication are discussed by 21 participants. (BBB)

29308 EFFECTS OF X-IRRADIATION OF TUBAL OVA ON EMBRYONIC DEVELOPMENT OF HAMSTERS. Elmer B. Harvey (Worcester Foundation for Experimental Biology, Shrewsbury, Mass.). J. Cellular Comp. Physiol., 63: 177-81(Apr. 1964).

Female hamsters were mated five hours after onset of estrus, then x irradiated at either the time of ovulation or two, four, six, eight or 12 hours after ovulation. At the time of ovulation 31% of the tubal ova were at meiotic prophase II and 69% at metaphase II. At two, four, six, eight, and 12 hours after ovulation, the ova were respectively 100% at metaphase II, 71% at anaphase II, 45% at early pronuclear stage, 66% at early pronuclear stage, and 92% at late pronuclear stage. The unfertilized and fertilized tubal ova were highly radiosensitive until eight hours after ovulation (early pronuclear stage) as ascertained by the high incidence of cleaved ova with micronuclei (36 to 71%) and embryonic degeneration before implantation (50 to 100%). At 12 hours after ovulation (late pronuclear stage), the incidence of micronuclei (5%) and degeneration of embryos before implantation (11%) was not significantly different from the controls. It was concluded that penetration of the ova by sperm does not protect the ovum from radiation effects, but rather it is more probable that the nature of the chromosomes in the pronuclei determines the level of radiosensitivity of the fertilized tubal ovum. (auth)

29309 EFFECTS OF SINGLE AND FRACTIONATED X-IRRADIATION OF OVARIAN OVA ON EMBRYONIC DEVELOPMENT OF THE HAMSTER. Elmer B. Harvey and M. C. Chang (Worcester Foundation for Experimental Biology, Shrewsbury, Mass.). J. Cellular Comp. Physiol., 63: 183-8(Apr. 1964).

Following x irradiation of estrus hamsters when their ovarian oocytes were at the first meiotic division, they were mated to fertile males and their ova were examined at the two-cell stage and their fetuses were examined

later. Irradiation at 25, 50, 100, 150, and 200 r, induced respectively 15, 41, 46, 45, and 61% of the ova with micronuclei and 30, 58, 74, 70, and 90% embryonic degeneration. Thus, the proportion of embryonic degeneration appears to be related to that of the ova with micronuclei following irradiation of ovarian ova. No significant difference however, was found in the proportion of ova with micronuclei and that of embryonic degeneration when hamsters were irradiated with a single dose of 50 r or a fractionated dose of 50 r by repeating 25 r either at an interval of 5 minutes or at an interval of 60 minutes. The proportion of degeneration before implantation increased markedly when irradiation was increased from 25 to 50 r, while that of degeneration after implantation increased markedly when irradiation was increased from 50 r to 100 r. A higher proportion of degeneration occurred before than after implantation. The number of ovulations, ova fertilized, and the cleavage of the fertilized ova were neither increased nor decreased by the irradiations of ovarian ova three hours before their release. Only eight abnormal fetuses were found among 350 viable fetuses examined. (auth)

29310 LOSS OF NUCLEOTIDE AND AMINO ACID POOL COMPONENTS FROM YEAST CELLS FOLLOWING EXPOSURE TO ULTRAVIOLET AND PHOTOREACTIVATING RADIATIONS. S. J. Siegel and P. A. Swenson (Univ. of Massachusetts, Amherst). J. Cellular Comp. Physiol., 63: 253-60(Apr. 1964).

Yeast cells suspended in water leak 260 mμ absorbing materials and amino acids into the suspending medium. At the same time the nucleotide and amino acid pool levels increase. Ultraviolet radiations (UV) cause increased leakage of 260 mμ absorbing materials and amino acids. Following low doses of UV, the pool levels rise above those of the non-irradiated cells, but at high doses they fall to zero over a six-hour period. Photoreactivating (PR) light modifies the leakage and pool relationships, but there is no clear evidence of photoreactivation for any of the effects studied. For the nucleotide system following low doses of UV, photoreactivating light alters the pool and leakage levels in the direction of those for non-irradiated cells. However, this may not be photoreactivation because the changes are also in the direction of pool and leakage levels for cells receiving higher doses of UV. For the amino acid system following low doses of UV, there is definite evidence against photoreactivation of leakage. Following high doses of UV, photoreactivating light acts synergistically with the UV to cause additional damage to both amino acid and nucleotide systems. (auth)

29311 POSTIRRADIATION SACCHARIN AVOIDANCE IN RATS AS A FUNCTION OF THE INTERVAL BETWEEN INGESTION AND EXPOSURE. William A. McLaurin (Ames Research Center, Moffett Field, Mountain View, Calif.). J. Comp. Physiol. Psychol., 57: 316-17(Apr. 1964).

The present study explores the effect of four intervals between the first ingestion of saccharin solution and the onset of x irradiation on the post-treatment saccharin behavior of rats. The rats were subjected to delay periods of 3, 60, 120, and 180 min between cessation of saccharin ingestion and irradiation with 61-r, whole-body doses at 6 r/min. Similar groups were sham-irradiated and some had no fluid prior to irradiation. Observations for 24 post-treatment days with a choice of water and saccharin revealed no significant differences among experimental groups. The irradiated control groups evidenced significant avoidance behavior for four days. It was concluded that saccharin avoidance conditioning does not fall within the classical concept of conditioning and that other factors are needed to account for the avoidance behavior of the irradiated controls. The post-treatment saccharian avoidance behavior of the rats given no saccharin solution prior to exposure indicates that either some degree of the response is solely dependent upon radiation exposure, or that conditioning occurs between the physiological concomitants of radiation exposure and the discriminatory saccharin solution in the home cage. (BBB)

29312 FINE STRUCTURE OF THE MATRIX OF THE RESPONSE IN RAT INCISOR DENTIN TO INJECTED STRONTIUM. James A. Yaeger (Univ. of Illinois, Chicago). J. Dental Res., 42: 1178-82(Sept.-Oct. 1963).

Male Sprague-Dawley rats, 50 days old, were injected subcutaneously with 40 mg $SrCl_2$/100 g, administered as a 25% solution of $SrCl_2 \cdot 6H_2O$, and the animals were killed five days later. The interfibrillar material in the normal (control) pre- and postinjection matrix was lightly stained with phosphotungstic acid and either granular or vacuolar, as seen in bone. In Sr-injected rats in a layer of dentin matrix ~8 to 10 μ wide, parallel to the predentin and some distance from it; the interfibrillar spaces were larger than normal; and the material filling them was heavily stained and homogeneous rather than lightly stained and granular as in normal dentin. A comparison of microradiographs of the responses produced by Sr and F demonstrated that the Sr response has only a weak or questionable hypermineralized component. The dramatic alteration in matrix seen in the Sr response must therefore be within the hypomineralized component. It is suggested that the inhibition of aggregation of collagen into its fibrillar form could account for the inhibition of mineralization resulting in the hypomineralized component. (BBB)

29313 SOME EFFECTS OF GAMMA RADIATION ON THE HORN FLY. Leyburn F. Lewis and Gaines W. Eddy (Dept. of Agriculture, Corvallis, Ore.). J. Econ. Entomol., 57: 275-6(Apr. 1964).

The horn fly, Haematobia irritans, a widely distributed bloodsucking ectoparasite of cattle, was sterilized by irradiating pupae of both sexes with a γ-ray dose of 5000 r from a ^{60}Co source. In every test in which irradiated pupae mixed with normal pupae were allowed to emerge together in screened cages, the resulting eggs were less viable than control eggs, which indicated that treated males competed for mates with normal males with some success. With flies from batches of pupae irradiated with 1000, 2500, 5000, 10,000, and 25,000 r, excellent emergence occurred; however, only a few flies from the group receiving 25,000 r had the vitality to reach the host animal, and none survived 24 hr. Flies from pupae receiving 10,000 r reached the host, but were weak and short-lived. Vitality was normal in groups receiving 1000, 2500, and 5000 r. Viable eggs were obtained only from the batch receiving 1000 and 2500 r, but not after 5000 r. Irradiation of horn fly pupae with 5000 r did not materially affect the longevity of the resulting adults. It is concluded tentatively that both sexes of the horn fly were sterilized by a dosage of 5000 r. The flies used apparently were nonparthenogenetic, since no viable eggs were obtained from normal females caged with treated males. Methods are presented for obtaining horn fly eggs, for mass rearing these flies in the lab, and for sexing the newly emerged adults. (BBB)

29314 THE RESPONSE OF X-IRRADIATED LIMBS OF ADULT URODELES TO NORMAL TISSUE GRAFTS. II. EFFECTS OF AUTOGRAFTS OF ANTERIOR OR POSTERIOR HALVES OF SIXTY-DAY FOREARM REGENERATES.

Benjamin D. Stinson (Princeton Univ., N. J.). J. Exptl. Zool., 155: 1-23(Feb. 1964).

An evaluation was made of the maximal morphogenetic capacity of blastemata formed on irradiated limbs in response to autografts of anterior (radial) or posterior (ulnar) halves of normal forearm regenerates. Right forelimbs of adult newts (Triturus viridescens) were exposed to 1000 r of localized x irradiation. Both right and left forelimbs were then amputated through the mid forearm. Later in the experiment the animals were divided into three groups for amputation and grafting in various combinations. Left limbs of all three groups regenerated normally. About 12% of irradiated control limbs formed sizable regenerates, but the remaining limbs of this series manifested essentially complete inhibition of regenerative capacity. Irradiated limbs implanted with normal autografts regenerated with high frequency to produce half-hand regenerates with a maximum of two digits in most cases. These half-hand regenerates duplicated the original graft's asymmetry and were disharmonic relative to the irradiated stump. Only structures distal to the level of amputation through the normal graft were regenerated. Skeletal complements of these half-hand regenerates corresponded to a longitudinal half of a forearm as determined by histological sections and whole mounts stained to reveal the skeleton. The results indicate that normal grafts mediate the formation of regenerates on irradiated limbs through an autonomous developmental activity of the graft within a developmentally inert stump. (BBB)

29315 A COMPARISON OF X-IRRADIATED MELANOCYTES IN THE HAIR FOLLICLES AND EPIDERMIS OF BLACK AND DILUTE-BLACK DUTCH RABBITS. William E. Straile (Roswell Park Memorial Inst., Springville, N. Y.). J. Exptl. Zool., 155: 325-41(Apr. 1964).

X irradiation was used to induce the formation of melanin in nonpigmented melanocytes in the guard-hair follicles (large central follicles of the hair clusters) and in the superficial epidermis of adult Dutch rabbits. Melanocytes were also demonstrated by the use of the mutation dilute (d) that modifies the distribution and physiology of pigment cells. The skin was examined 20 to 50 days after irradiation with 1000 r, and pigmented melanocyte distribution was determined. Melanocytes in different parts of the hair follicle responded in distinct ways to x irradiation. It is suggested that melanocytes are resistant to the direct effects of x rays but are very sensitive to the radioinduced changes that occur in the surrounding cells of their particular tissue environment. (BBB)

29316 EFFECT OF IONIZING RADIATIONS ON PLANT TISSUES. III. SOFTENING AND CHANGES IN PECTINS AND CELLULOSE OF APPLES, CARROTS, AND BEETS. Z. I. Kertesz, R. C. Glegg, F. P. Boyle, G. F. Parson, and L. M. Massey, Jr. (New York State Agricultural Experiment Station, Geneva). J. Food Sci., 29: 40-8(Jan.-Feb. 1964).

Changes occurring in pectic and cellulose constituents of apple, carrot, and beet tissues, as a result of treatment with ^{60}Co γ radiation were studied. In apple tissues, degradation of both constituents occurred at ~ the dose (37 krad) at which tissue softening could be first demonstrated, and progressed with increasing dose. Although these findings were corroborated in carrot tissues (softening threshold ~170 krad), the softening of beets was not as clearly accompanied by such marked changes in pectins and cellulose. Pectin appears to be somewhat more susceptible to degradation by ionizing radiation than does cellulose. There was not a complete coincidence of the dose response of either pectin or cellulose degradation to that of tissue softening; however, it is possible that the additive effect of the two responses could account for the resultant softening. It is suggested that some additional factors, perhaps including changes in cell turgidity, are involved in the softening of plant tissue by γ irradiation. (BBB)

29317 TEMPORAL STUDIES ON SUPPRESSION BY X RAY OF ADAPTATION FOR THE SECONDARY ANTIBODY RESPONSE. Richard J. Porter (Univ. of Michigan, Ann Arbor). J. Immunol., 92: 425-30(Mar. 1964).

A study was directed to the question of whether the state of secondary antibody response adaptation in rabbits underwent a change in radiosensitivity with time following the first injection of antigen. Suppression of adaptation for a secondary antibody response was studied in rabbits exposed to severe whole-body x-radiation at various intervals after an injection of bovine γ-globulin (BGG). The tanned-cell hemmagglutinin response to a test reinjection of BGG at least 49 days after x radiation was used to assess the degree of suppression. Administered four to 42 days after antigen, 450 r gave irregular results. A dose of 500 r administered seven to 31 days after antigen gave similarly inconsistent supression, but this dose of x rays administered 35 to 378 days after antigen resulted in essentially complete and permanent erasure of immunologic memory, so that the treated animals manifested typical responses of primary grade after reexposure to antigen. The results suggest that the attainment of a stable condition of adaptation for secondary antibody formation is a slow process. The evidence supports the view that the observed effects reflect x-ray injury to cells or systems responsible for the long-term maintenance of secondary responsiveness. (BBB)

29318 ANTIGENIC SPECIFICITY OF BENZO[a]-PYRENE-INDUCED SARCOMAS. Amiela Globerson and Michael Feldman (Weizmann Inst. of Science, Rehovoth, Israel). J. Natl. Cancer Inst., 32: 1229-43(June 1964).

Tumors induced in C3H and C57BL mice by benzopyrene elicited isograft immune reactions to tumor-specific antigens. The antigenicity of primary tumors was higher than that of the same sarcomas after a series of transfers through isologous hosts. Apparently the progressive growth of transplants of primary tumors is determined by the antigenicity of the tumors. Sarcomas that did not take in normal hosts, such as grafts of early transplant generations, grew progressively when transplanted to animals exposed to total-body x irradiation, i.e., in immunologically suppressed animals. The decrease in antigenicity was not associated with a complete loss of the tumor antigens. Tumors that could no longer immunize animals were still susceptible to the immune response elicited by immunogenic grafts of earlier transplant generations. Each of the 2 sarcomas produced in a single animal by 2 simultaneous applications of the carcinogen had distinct antigenic specificity. It was concluded that tumors produced in a single animal may differ from each other in transplantability, immunogenicity, and antigenic specificity. The exposure of preimmunized animals to x irradiation, followed by test grafting, was most useful for the analysis of antigenic specificity of non-transplantable tumors. Experiments in which sarcomas, originating in C3H, were tested for antigenicity in (C3H × C57BL)F_1 hybrids demonstrated that the lack of manifested immunological reactivity to certain tumors is due to the properties of the tumor cells themselves and not to the recipient animals. (auth)

29319 A REVIEW OF THE ACUTE RADIATION SYNDROME IN DOMESTIC ANIMALS. PART I. LETHAL STUDIES. J. H. Wilkens (Army Veterinary and Remount Services, Droitwich, Eng.). J. Roy. Army Vet. Corps, 33: 74-82(Autumn 1962).

The effects of ionizing radiations on large animals, especially equine species, cattle, pigs, sheep, and dogs, are considered, with reference to previously published reports. Unpublished observations using 250-kv x irradiation at a dose rate between 11 to 13 r/min places the MLD of goats somewhere between 500 and 650 r, which is similar to that of sheep. Survival time was also longer than that found previously. Variations in lethality in relation to quality and type of radiation are also considered. (BBB)

29320 A REVIEW OF THE ACUTE RADIATION SYNDROME IN DOMESTIC ANIMALS. III. PATHOLOGICAL ASPECTS. J. H. Wilkens (Army Veterinary and Remount Services, Droitwich, Eng.). J. Roy. Army Vet. Corps., 34: 64-73(Autumn 1963).

Pathologic alterations in tissues, largely a function of survival time, are discussed in terms of acute radiation syndrome in mammals. Some possible sequelae of irradiation are considered such as: cataractogenesis, carcinogenesis, and premature aging. Radioinduced life-shortening is defined in view of reparable and irreparable radiation injury. (H.M.G.)

29321 PHENOMENON OCCURRING IN ENZYMES UNDER THE INFLUENCE OF X AND GAMMA RAYS. Jerzy E. Maruchin and Slawomir R. Lipski. Kosmos (Warsaw) Ser. A, 13: 138-47(1964). (In Polish)

29322 DEVELOPMENT OF THE CONCEPT OF THE X-RAY DOSE. Gyula Koczkas (Orszagos Frédéric Joliot-Curie Sugárbiologiai Kutató Intézet, Budapest). Magy. Radiol., 15: 215-21(Aug. 1963). (In Hungarian)

The controversy over the proper definition of x-ray dose and proper designation of units of radiation doses is discussed. It is recommended that ion dose be designated simply dose; the absorbed dose be designated energy dose, the units being indicated by r and rad, respectively. (BBB)

29323 VISUAL ASPECTS OF RADIATION EXPOSURE. James F. Culver (School of Aerospace Medicine, Brooks AFB, Tex.). Military Med., 126: 677-8(Sept. 1961).

A review shows that the size and severity of optic lesions depend upon the radiant emittance of the source, duration (limited by a blink reflex), size of pupillary aperture, and the specific absorption and attenuation of the atmosphere and ocular media. USAF School of Aerospace Medicine to clarify further the cataractogenic threshold dose for man are described, as well as studies on the effects of protons and α particles of high energy. (BBB)

29324 HUMAN ABILITY TO PERFORM AFTER ACUTE SUBLETHAL RADIATION. Robert W. Zellmer (School of Aerospace Medicine, Brooks AFB, Tex.). Military Med., 126: 681-7(Sept. 1961).

Latent effects of radiation exposure are discussed with reference to a typical problem in which a crew member or ground party is suddenly exposed to, or needs to accept, certain amounts of radiation (γ radiation from a fallout field or from the radiation envelope of an air burst). Performance during their mission or at some short time after this exposure is predicted under various circumstances. The conditions were approximated in the lab using the rat and the rhesus monkey. Thus there was no change in the learning or retention of rats exposed to 200 to 500 r of total-body x irradiation, and when the heads only of rats were exposed to 300 to 800 r, there were no significant changes in the ability to learn or to retain learned tasks. There was little or no change in the performance of rats following exposure to 100–1000 r, although there was a decrease in activity immediately following irradiation, attributed to a general malaise of the typical acute radiation syndrome. The same parameters were tested in rhesus monkey, with essentially the same results. Data are also presented from Japanese survivors and cancer patients exposed to whole-body radiation doses (15 to 200 r). The results in these patients showed that there was no significant difference between the performances of those patients who had single doses and those who had multiple doses; in no case was there a decrement in performance, in learning, or retention of learned tasks that could be ascribed to radiation, even at a 200-r dose. From these data some predictions as to the performance of military personnel following acute whole-body doses of 600 rad or less are made. Many factors, such as motivation and individual susceptibility, affect performance of troops during wartime or disaster situations, and thus the predictions can be as much as 100% wrong in individual cases. Much more data from human experience must be accrued before firm predictions can be made. (BBB)

29325 TRANSFER OF STIMULATION OF DEOXYRIBONUCLEIC ACID SYNTHESIS IN ANTIGEN-STIMULATED RABBIT SPLEEN CELL CULTURES. R. W. Dutton and G. Harris (Postgraduate Medical School, London). Nature, 197: 608(Feb. 9, 1963).

A system of rabbit spleen cells and human albumin serum was used to test whether cells primed by brief contact with the antigen are able to transfer stimulation to fresh cells from the same spleen. The response of the primed cells was inhibited by irradiation or freezing and thawing. One portion of the primed cells received a dose of 300 rad. Another portion of primed cells was frozen and thawed once. Cultures of such cells were incubated alone or in various combinations, and the rate of DNA synthesis was measured in the second 24-hr period by incubation with ^{14}C-thymidine. A definite enhancement of DNA synthesis was observed when primed cells were incubated with control cells. This was clearly shown when DNA synthesis was inhibited in the primed cells. There was no enhancement of DNA synthesis when control irradiated cells were added to control cells or to primed cells. The enhancement of DNA synthesis obtained when primed cells, which were frozen and thawed, were added to control cells demonstrated that it is the control recipient cells which respond. The results indicate that: the primed irradiated cells contain some factor capable of stimulating DNA synthesis in control recipient cells, and the presence of this factor is dependent on contact of the primed cells with specific antigen. The nature of this transfer factor is unknown but at least three possibilities exist: the minute quantity of antigen taken up represents an extremely potent fraction of the original antigen preparation; the antigen taken up has had its antigenicity enormously enhanced; the cells taking up the antigen hand on some material, other than antigen, which is capable of stimulating cell division. (BBB)

29326 RECOVERY OF HYPOXIC MAMMALIAN CELLS FROM SUBLETHAL X-RAY DAMAGE. M. M. Elkind, T. Alescio, R. W. Swain, W. B. Moses, and H. Sutton (National Cancer Inst., Bethesda, Md.). Nature, 202: 1190-3(June 20, 1964).

The recovery of Chinese hamster cells in tissue culture from sub-lethal x radiation injuries under anoxic and aerobic conditions was measured by the two-dose technique. Results of a series of experiments showed that reduced

oxygen tension resulted in a lack of a pronounced minimum in the two-dose survival response, indicating that repair of sub-lethal damage did not require either metabolism at optimum growth temperatures or oxidative metabolism. It is postulated that the progressive loss of the ability of anoxic cells to develop the minimum characteristic of aerobic cells is due to more than differences in cell movement and that, in addition to possible age-dependent changes in single-dose response, hypoxia may induce qualitative changes in responses to fractionated radiation doses. (C.H.)

29327 EFFECT OF WHOLE-BODY IRRADIATION ON THE UPTAKE OF SULPHUR-35 AS SODIUM SULPHATE INTO RAT BRAIN SULPHATIDES. W. E. Cornatzer and Cecil H. Chally (Univ. of North Dakota, Grand Forks). Nature, 202: 1224-5(June 20, 1964).

Whole-body x radiation doses of 500 r caused a decrease in the uptake of ^{35}S-sulfate into brain sulfatides in rats. Possible reaction mechanisms involved are discussed. (C.H.)

29328 STARCH-GEL ELECTROPHORESIS OF SERA OF IMMUNIZED X-IRRADIATED MICE. S. Muramatsu (Kyoto Univ.). Nature, 202: 1230-1(June 20, 1964).

Starch-gel electrophoretic patterns were compared for mice exposed to 500 r whole-body x radiation, given subcutaneous injection of 3 mg bovine γ-globulin, or given γ-globulin and exposed to 500 r whole-body x radiation. Antibody titers were also determined. No significant changes were observed in γ-globulin fractions. It was concluded that immunological unresponsiveness induced by x radiation is the result of disturbances in serum protein metabolism rather than overall reduction in γ-globulin levels in serum. (C.H.)

29329 RADIOSENSITIVITY OF THE AGEING BRAIN. Antonia Vernadakis, Nancy Sherwood, Stanley Geel, and Paola S. Timiras (Univ. of California, Berkeley). Nature, 202: 1232-4(June 20, 1964).

Electroshock stimulation of the brain was used in studies of the effects of age or radiosensitivity of rat brain. The results showed a decreased radiosensitivity of the nervous system with age. Possible mechanisms involved are discussed. (C.H.)

29330 SODIUM EXCRETION AS A FACTOR CAUSING DEATH IN FISH DUE TO IRRADIATION. P. N. Srivastava and C. Tachi (National Inst. of Radiological Sciences, Chiba-shi, Japan). Nature, 202: 1234-5(June 20, 1964).

Doses of 8000 r x radiation increased the excretion of ^{22}Na through the gills of goldfish, Carassius auratus. The mean survival time after 8000 r irradiation was approximately 9 days. Tracer studies of ^{22}Na excretion in irradiated and control fish, and partially-irradiated fish indicated that excessive Na loss by irradiated fish may cause an imbalance in osmoregulation and result in death. (C.H.)

29331 GIANT CELLS BY β RADIATION. A. V. Szilvinyi and Gerda Kernmayer (Institut für Angewandte Mikrobiologie, Vienna). Naturwissenschaften, 51: 241-2(1964). (In German)

Giant cells as an effect of irradiating Candida tropicalis with beta particles were investigated and compared with results on animal cells. The giant cells were found to contain a considerable amount of DNA. The giant cells appeared to be direct results of irradiation and reproduced by budding. (M.C.G.)

29332 THE EFFECT OF X-RAY ON THE ENERGY METABOLISM OF MOUSE EHRLICH ASCITES TUMOR CELLS. Kozo Inaba (Okayama Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 22: 1198-1203(Feb. 25, 1963).

Whole-body irradiation of tumor-bearing mice was conducted with 100-, 500-, and 1000-r doses of x rays, at various periods the Ehrlich ascites tumor cells were removed, and oxygen uptake and ^{32}P incorporation by the tumor cells were determined. Oxygen uptake of the tumor cells was enhanced, but the P/O ratio decreased 24 hr after whole-body irradiation with the dose of 1000 r. Tumor cells removed from the irradiated tumor-bearing mice displayed a marked increment in aerobic lactate formation in the presence of glucose. A swelling action on rat liver mitochondria was especially evident with the lipid fraction from the ascitic fluid of the x-irradiated tumor-bearing mice. The swelling action of water-soluble and lipid fractions from the ascitic fluid was tested to determine in which fraction the uncoupler of oxidative phosphorylation resides. (BBB)

29333 FREE RADICALS IN IRRADIATED BOVINE HEMOGLOBIN. Tadaharu Nosaki (Osaka Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 181-8(May 25, 1963). (In Japanese)

Radiation damage from exposure of the bovine hemoglobin molecule to ^{137}Cs was studied by physico-chemical methods. The experiments were carried out by electron spin resonance studies and amperometric titration of SH groups in the hemoglobin, irradiated both in solution and in dry form. Free radicals in hemoglobin powder increased in proportion to the radiation dose (from 10 to 700 kr) in both aerobic and anaerobic states. After irradiation the free radicals of the samples in the aerobic state decreased gradually. On the other hand, the free radicals of the samples in anaerobic state initially increased post-irradiation and then decreased slowly. The difference between aerobic and anaerobic conditions indicates an oxygen effect. Free radicals were also found in irradiated aqueous solutions of hemoglobin. Amperometric titration disclosed the disappearance of SH groups in the irradiated hemoglobin in both aerobic and anaerobic states. Also in this case an oxygen effect was considerably in evidence. A proportionality between free radical formation and disappearance of SH groups was noted. It is concluded that the formation of an S· radical occurs at an early stage of the radiation damage in hemoglobin. The formation of S· radicals was also demonstrated in irradiated cysteine crystals (in the presence of air). (BBB)

29334 EXPERIMENTAL STUDY OF THE TEST OF MOBILIZATION OF GRANULOPOIETIC RESERVE OF BONE MARROW AFTER IRRADIATION. Claude Levy (Institut du Radium, Paris). Nouvelle Rev. Franc. Hematol., 3: 773-8(1963). (In French)

Experiments were conducted to evaluate the usefulness of the pyrogen test, which indicates the capacity of the bone marrow to produce granulocytes, in myeloid hypoplasia or aplasia following whole-body irradiation. Also a chronologic comparison was made of myeloid destruction and peripheral neutropenia. The pyrogen test is conducted by injection of Salmonella abortus equi lipopolysaccharide (Pyrexal) in rabbits, which results in a fall in circulating neutrophils 2 hr later, followed by an elevated count 4 hr after injection. This 2-fold increase of leukocytes by the fourth hour is accompanied by a rise in body temperature. Markedly different responses in this test were observed in rabbits irradiated with a lethal dose (950 r) of 250-kv x rays 8 days before testing. The already low neutrophil level fell to very low levels 2 hr after pyrogen injection and the 4-hr rise in the count was not observed. Even at 4 days

after irradiation the 4-hr rise in leukocytes was lacking in about half of the rabbits, indicating that the marrow granulopoietic reserve is depleted at this time also. In contrast to the response of nonirradiated rabbits, monocytes (including lymphocytes) were less affected than granulocytes four hr postinjection. It is suggested that the well-known postirradiation increase in neutrophils selectively depletes the bone marrow of these cells. (BBB)

29335 EFFECT OF IRRADIATION ON GLYCOLYSIS IN NORMAL AND NEOPLASTIC TISSUE DURING PERFUSION. L. Cappelli and M. Santoro (Istituto Regina Elena per lo Studio e la Cura dei Tumori, Rome). Oncologia, 17: 101-6(1964). (In Italian)

In continuation of earlier studies, in which it was found that radiation doses up to 4000 r progressively lowered the oxygen consumption of normal and tumor tissue, the effect of 200-kv x irradiation on the in vitro glycolytic activity on the tissues was investigated. Chicken wings, in some cases after inoculation of the birds with Rous sarcoma, were perfused with Ringer glucose-bicarbonate solution, then irradiated with doses of 2000 to 4000 r, and fragments of normal and neoplastic tissues were removed and their aerobic glycolytic activity estimated by the manometric (Warburg) method. The tissue fragments were removed and assayed at 30, 60, and 90 min after irradiation, perfusion being continued during this interval. After 2000-r irradiation, glycolysis (expressed as $Q_{CO_2}^{O_2}$) rose ~ 30% in normal tissue at 30 min, then declined to below normal values at 90 min; in sarcoma tissue the initial stimulation of glycolysis was greater, as was the later decrease. However, the early (30-min) rise in aerobic glycolysis was partially masked by a similar early stimulation in perfused, nonirradiated tissue, which did not show the late decrease seen in irradiated tissues. After 4000 r, similar but slightly more marked changes were noted. It is concluded that after a slight initial stimulation, which is more marked in neoplastic than normal tissue, aerobic glycolysis is depressed by irradiation. The greater stimulation in tumor cells may be related to their disaggregation by irradiation and oxidation of some metabolites released from the cells. It is considered that the results of these experiments are more valid than some of the conflicting results of earlier studies, since here the use of an isolated organ, continuously perfused after irradiation, allowed more homogenous serial samples to be obtained for metabolic assays. (BBB)

29336 ULTRASTRUCTURAL CHANGES IN HEART MUSCLE CELLS FOLLOWING FRACTIONAL ROENTGEN IRRADIATION. E. Morano and S. Boccardi (Università, Milan). Panminerva Med., 6: 58-61(Mar. 1964).

Fractionated x radiation doses were administered to muscle cells in a single session each day over a total period of 10 days. In this way it was possible to administer a high total dose without lethal outcome and to obtain a basis for comparing the single vs. fractionated irradiation methods and their effects on muscle. A 4-cm diameter region over the heart of guinea pigs was x irradiated at 160 kv, providing a fractionated dose of 300 r per session to a total dose of 3000 r. The animals were killed 48 hr after the last treatment, and thin sections of myocardium were prepared and examined by electron microscopy. As expected, at the ultrastructural level, the extent of damage to the cytoplasmic elements were severe. However, there was no reduction in the number of mitochondria, the internal structure of which had undergone changes. It was concluded that lesions of the cytoplasmic organelles are found to appear more consistently after fractionated irradiation (a total dose of 3000 r) than after a single large dose (1000 r). (BBB)

29337 DISORDERS OF THERMOREGULATION PROCESSES IN RABBITS IN EXPERIMENTAL TRANSFUSION SHOCK AND AFTER IRRADIATION. Josef Panasewicz and Krystyna Marczak (Zakladu Fizjopatologii, Warsaw). Polskie Arch. Med. Wewnetrznej, 32: 829-37(1962). (In Polish)

Alterations in thermoregulation processes in experimental transfusion shock and after irradiation with large doses of ionizing radiation were investigated in 119 cats and rabbits. It was shown that in experimental anaphylactic shock after transfusion and in traumatic shock the temperature fell continuously until death. Pyrogenic reactions, elicited in rabbits by purified bacterial lipopolysaccharides, become weaker, absent, reversed, or biphasic in anaphylaxis. In citrate shock, on the other hand, they increased, as compared with the control values. Three types of disturbances of the thermoregulation processes were seen in cats with acute, irreversible radiation disease: gradual rise of the temperature continuing until death, gradual rise of the temperature followed by a fall (but not below starting values), and eventually a gradual rise of temperature followed, at the terminal stage, by a sharp fall below starting values. Irradiation of rabbits with the doses of 600 to 800 r did not influence significantly the pyrogenic reaction due to injection of purified bacterial lipopolysaccharides. Sometimes a slight positive or negative alteration of the pyrogenic reaction was seen, as well as its lability at various stages of the disease. It is suggested that these abnormalities occurring in both shock and acute radiation disease are due to disturbances of the processes of chemical and physical thermoregulation and to the impairment of thermoregulation centers in the midbrain. (BBB)

29338 THE EFFECT OF X-RADIATION ON THE SPERMATOGENESIS OF PETROBIUS MARITIMUS. R. S. Mathur (Trinity Coll., Dublin). Proc. Roy. Irish Acad., Sect. B, 61: 275-81(Mar. 1961).

Testes of Petrobius maritimus given 300 and 500 r doses of x rays were prepared for cytological examination. Irregularities in spermatocyte Golgi bodies proved to be the most significant cytoplasmic change. However, a radioinduced lag effect was noted in aggregation of mitochondrial granules. The nucleus remained normal except that the chromatin material condensed into thick fibers. (TCO)

29339 THE RELATIVE BIOLOGICAL EFFICIENCY OF 20-Mev ELECTRONS AND 250-Kvp X-RAYS IN SACCHAROMYCES CEREVISIAE INACTIVATION. A. Mookerjee, J. G. Van Dyke, and J. S. Laughlin (Sloan-Kettering Inst., New York). Radiation Res., 22: 431-9(July 1964).

Experiments comparing the inactivation of yeast cells by 20-Mev electrons and 250-kvp x rays were performed. It was found that the relative biological efficiency (RBE) obtained, either 0.81 or 1.00, varied from one cell population to another for reasons that are not understood. It may only be remarked that the variation in RBE is in some way related to the age of the population and its budding state and that yeast does not appear to be a suitable system for further study of the problem. (auth)

29340 SYNERGISTIC EFFECTS OF P^{32} DECAY AND ULTRAVIOLET IRRADIATION ON INACTIVATION OF SALMONELLA. Yonhon Yan and Sohei Kondo (National Inst. of Genetics, Misima, Japan). Radiation Res., 22: 440-56(July 1964).

In Salmonella typhimurium, ^{32}P suicide experiments and

interaction experiments between ^{32}P decay and uv irradiation were carried out. The efficiency of killing per ^{32}P decay in the total DNA of a cell was 1.2×10^{-2} at −20°C. Synergism of ^{32}P decay and the uv photoproduct was observed. This synergism was almost completely eliminated by photoreactivation. Reciprocity in the synergism was observed; that is, the magnitude of the synergism was independent of the order of uv and ^{32}P treatments. A method for theoretical analysis of the synergism is proposed. From such an analysis it was concluded that when a uv damage, that is, thymine dimer, and a ^{32}P decay occur in the double-stranded DNA of a cell within a distance about 25 nucleotide pairs, and the former occurs in the strand opposite to that bearing the latter, interaction between the two different damages results in inactivation of the cell. The mechanism of the ^{32}P lethal effect is discussed, and a model for the mechanism is proposed. The synergism observed between uv and γ radiations is briefly mentioned. (auth)

29341 $LD_{50(24\ hours)}$ OBSERVATIONS IN THE CHICK EMBRYO AFTER EXPOSURE TO X-RAYS. Neal K. Clapp (Colorado State Univ., Fort Collins). Radiation Res., 22: 457-62(July 1964).

An estimation of $LD_{50(24\ hr)}$ for chick embryos 2 to 19 days old exposed to x radiation is presented. Two-day-old embryos showed a relative radioresistance, whereas embryos at ages 7 and 8 days and at ages 16 to 18 days were observed to be relatively more sensitive to the effects of ionizing radiation. The mean $LD_{50(24\ hr)}$ for ages 3 through 19 days was 826 r. (auth)

29342 A BIOCHEMICAL STUDY OF THE X-RADIATION-INDUCED INHIBITION OF SODIUM TRANSPORT (Na PUMP) IN HUMAN ERYTHROCYTES. F. Bresciani, F. Auricchio, and C. Fiore (Università, Naples and Brookhaven National Lab., Upton, N. Y.). Radiation Res., 22: 463-77(July 1964).

In human erythrocytes under aerobic conditions, glycolysis was not decreased during the first hour after x irradiation with 890 to 8900 rads. On the contrary, a slight but definite increase was observed after the larger doses: ~20% and ~35% after 4450 rads and 8900 rads, respectively. The ATP, ADP, and AMP content of the cells measured one hour after 890 rads or 1780 rads was not changed; 4450 rads and 8900 rads induced a decrease of ADP and AMP which was accounted for by an increase in ATP content. The ATPase activity of membranes of erythrocytes consists of two components. The first one requires the presence of Mg but occurs in the absence of Na and K, and it is not inhibited by cardiac glycosides. This component was slightly impaired after x irradiation: ~31% decrease after 8900 rads. The second component requires the presence of Mg and also of both Na and K; it is inhibited by cardiac glycosides, and it is generally accepted to correspond to the mechanism of the Na pump in the membrane. This component is more radiosensitive, and its curve of inhibition coincides with the curve of inhibition of active Na transport (Na pump) in intact erythrocytes; the dose-effect curve can be decomposed into two pure exponential functions of the dose of x rays, with $D_{37} \cong 740$ rads and 10,700 rads. It was concluded that x rays inhibit active Na transport by interfering with the pumping mechanism in the membrane and, on the basis of a number of facts, the two functions into which the (K−Na)ATPase dose-effect curve can be decomposed were given the physical meaning of two metabolic reactions in the membrane with different radiosensitivities to x rays. A theoretical, general analysis is presented of forms of dose-effect curves expected in cases where two (or more) reactions simultaneously affected by radiations are in the same pathway or in parallel pathways. The term parallel is used to indicate different pathways which have, however, one or more substrates and/or metabolites in common. When the study is limited to the kinetics of a common metabolite, therefore, the two contributing lines of metabolism are indistinguishable, and an over-all, total velocity is measured. In general, this is a rather frequent case to deal with. Within the limits of the system discussed, a result of general interest is that, on a semilogarithmic plot, the first case gives curves that are straight or show a downward concavity, and only in the second case are curves obtained with a concavity upward. The dose-effect curve for the (K−Na)ATPase activity belongs to the family of curves of the second case. The x irradiation analysis suggests, therefore, the existence of two parallel biochemical mechanisms in the membrane of erythrocytes, both of which transport Na outward at the expense of ATP hydrolysis. (auth)

29343 CYTOGENETIC STUDIES ON RADIORESISTANT CELLS DERIVED FROM MOUSE STRAIN L CELLS IN CELL CULTURE. Masakatsu Horikawa, Yukio Doida, and Tsutomu Sugahara (Kyoto Univ.). Radiation Res., 22: 478-88(July 1964).

A cell line resistant to ionizing radiation was isolated from the original mouse strain L cells and was designated Lγ7. The various cytogenetic properties of these resistant cells were investigated. The Lγ7 cells manifested a resistance to radiation. The degree of resistance was not so high, however, as the degree of resistance to various chemical and physical agents exhibited by the variants. It was calculated that the mean generation time of the original L cells was 27 hr during the logarithmic phase of growth, whereas that of the Lγ7 cells was 84 to 90 hr. Their cell morphology also differed from that of the original L cells; the Lγ7 cells were spherical, whereas the original L cells were fibrous. The original L cells had a mode of chromosome number at 63. The Lγ7 cells exposed to total doses of 14,000 r had a mode of 44 chromosomes. Thus there was a shift in chromosome number. This decrease in chromosome number in the latter cells was gradually derived by seven repeated γ irradiations of 2000 r each. It was indicated that a correlation may exist between chromosome number and radioresistance in mammalian cells. In addition, the shift in the chromosome number of the radioresistant cells from the original L cells seems to suggest that the appearance of radioresistant cells (Lγ7 cells) depends on repeated spontaneous or radioinduced mutations. (auth)

29344 CATARACT DEVELOPMENT AFTER EMBRYONIC AND FETAL X-IRRADIATION. Roberts Rugh, L. Duhamel, A. Chandler, and A. Varma (Columbia Univ., New York). Radiation Res., 22: 519-34(July 1964).

CF1 Swiss mice were x rayed at various stages of embryonic development, from fertilization to 18 days of gestation, to either 10 or 100 r, and were examined, along with parallel controls, at 4, 6, 9, and 12 months of age for the incidence of cataracts. A total of 14,656 eye examinations was made with the slit-lamp. It was found that 10 r did not alter statistically the incidence of cataract formation during the 12-month study; therefore the data presented here relate only to 100-r exposure level. The most radiosensitive time, for either male or female, occurred at or immediately after fertilization of the egg, prior to the first cleavage. (The greatest sex difference in cataractogenesis occurred with irradiation at 3 days, long before sex dif-

ferentiation is known to occur.) Sensitivity was measured by the incidence of lenticular abnormalities (cataracts). Some 60% of the eyes of mice exposed at this time (0.0 day) developed cataracts by 12 months of age, whereas among the parallel controls it was only 7.2%. This was an eight-fold increment, when each eye is considered independently. More frequently than not, a mouse with one cataract also had a cataract in the other eye. If the data are presented in terms of mice with cataracts, rather than eyes with cataracts (because of the correlation between the two eyes), it is found that x irradiated males had 33% with cataracts, as opposed to 5.2% for their controls. The females showed a lower disparity, from 28% among the x-rayed to 12.8% among the controls. When the data are analyzed by taking into consideration the deaths and the time of their occurrence, and the probabilities, it is seen that there is little difference in cataract increment between all the irradiated males and all the irradiated females. There is indeed evidence of a very significant statistical difference in the x irradiation of either male or female at the earliest stage, namely at fertilization and zygote stage. Since the incidence of cataract formation among mice x irradiated during embryonic eye and lens formation was not particularly or significantly high, as compared with the results of irradiating at the earlier fertilization stage, it is suggested that cataracts in embryonic-irradiated mice are indicators of over-all damage or debility rather than of direct and specific effects on lens epithelium. This is supported by the fact that the $LD_{50(30)}$ values for the mouse embryo paralleled those for cataracts among the survivors. Cataracts of both the nuclear and cortical types were found also in the controls beginning at 6 months, but never in the frequency nor intensity in which they were found in the embryonically x-rayed mice. By 12 months the incidence among all mice irradiated in utero was approximately three times that of the parallel controls. It was emphasized that cataractogenesis is calculated among the mice that survived embryonic and fetal x irradiation. Those with the highest incidence of cataracts at 12 months of age were exposed to 100 r at the most radiosensitive period of development (0 to 1 day), so that only 25% lived to 12 months of age, and 78% of these developed cataracts. The greatest cataractogenic effect followed irradiation long before the differentiation of the eye began. (auth)

29345 ENVIRONMENTAL CONDITIONS AFFECTING THE EXPRESSION OF X-RAY-INDUCED LETHALITY IN AN AUXOTROPHIC BACTERIUM. Daniel Billen and G. N. Jorgensen (Univ. of Texas, Houston). Radiation Res., 22: 535-42(July 1964).

The influence of postirradiation nutritional deprivation on cell survival was studied in a multi-auxotrophic bacterium E. coli strain $T^-A^-U^-$. Latent lethal effects were expressed in this mutant bacterium if any of the required supplements, either thymine or arginine and uracil, were omitted from the liquid medium during the postirradiation incubation prior to final plating on a completely supplemented agar medium. The postirradiation effect does not appear to be due to toxic substances induced in the medium as a result of irradiation. The possibility that the portion of the cells subjected to immediate lethal damage may release infectious or toxic agents was explored by using nonirradiated cells suspended in the cell-free supernatant after postirradiation incubation. Cell death was not observed in this latter circumstance. The aftereffect noted with irradiated cells incubated in liquid medium was greatly modified if the cells were post-treated on a filter paper carrier under conditions of nutritional deficiency. The possibility is discussed that the nutritional deficiency leading to cessation of DNA or RNA and protein synthesis results in the expression of lethal injury otherwise repaired. (auth)

29346 LIPOGENESIS AND CHOLESTEROGENESIS IN THE WISTAR RAT PAROTID GLAND AFTER UPTAKE OF CALCIUM-45. Michael E. Fritz, D. Walter Cohen, and Joseph L. Rabinowitz (Univ. of Pennsylvania, Philadelphia and Veterans Administration Hospital, Philadelphia). Radiation Res., 22: 543-7(July 1964).

The rate of in vitro synthesis of cholesterol and fatty acids from precursor acetate-2-^{14}C was measured by using the parotid glands of 22 Wistar rats, 8 of which received an intraperitoneal injection of 1 μC of $^{45}CaCl_2$, and 6 of which received an intraperitoneal injection of $NaH^{32}PO_4$. By means of homogenate preparations, the parotid glands of animals that received the ^{45}Ca were shown to produce significantly more de novo synthesis of both fatty acids and cholesterol. There was no significant difference in lipogenesis, cholesterogenesis, or ^{45}Ca uptake in the right and left parotid glands. Histologic sections of the glands showed pathologic changes in those animals that received the ^{45}Ca in the dosages and times studied. No such effects were found on the salivary glands of the ^{32}P and nonradioactive Ca-treated animals. (auth)

29347 THE PERSISTENCE OF ELECTRON SPIN RESONANCE IN BONE GRAFTS STERILIZED BY IONIZING RADIATION. Ursula T. Slager, Melvin J. Zucker, and Emmett B. Reilly (Univ. of Southern California, Orange; Orange County General Hospital, Orange; and Hughes Aircraft Co., Newport Beach, Calif.). Radiation Res., 22: 556-63(July 1964).

Bone grafts, sterilized by ionizing radiation, show electron spin resonance which persists for at least 12 weeks when stored in a bone bank (in vitro) and for 2 weeks after implantation into the body of a dog (in vivo). The resonance seems to disappear with the ingrowth of new tissue from the host and the reorganization of the bone graft by new living host cells. (auth)

29348 THE INFLUENCE OF IRRADIATED BASIC PROTEINS ON THE LIGHT-SCATTERING PROPERTIES OF RIBONUCLEIC ACID: A RADIATION PROTECTION STUDY. John W. Preiss (Univ. of Delaware, Newark). Radiation Res., 22: 564-76(July 1964).

Small quantities of basic proteins that irradiated in the dried state increased the turbidity of RNA solutions to which they were subsequently added. The resulting excess turbidity/electron-dose functions were nonmonotonic. Their shapes were different when the irradiated protein layers contained other substances. Some of these added substances reduced the radiosensitivity of the basic protein, as an enzyme. When they were, on a weight basis, very efficient in this respect, they were also very efficient in shifting the maxima of the excess turbidity/electron-dose curves toward higher doses. All tested substances changed the amplitude of the curves. (auth)

29349 EXPERIMENTAL RESEARCH ON THE POSSIBLE RADIOSENSITIZATION ACTION OF THYROXINE. C. Martinenghi and R. Sorrentino (Università, Milan and Ospedale Maggiore, Novara, Italy). Radiobiol. Latina, 6: 105-18(Apr.-June 1963).

The possible radiosensitization induced by thyroxine was studied. Various groups of white mice were irradiated and treated with thyroxine and the type of association was changed in different animal groups. It was shown that thyroxine significantly increases the lethal

effect of roentgen therapy in the mice receiving a median lethal dose (650 r in one single application) and that this effect is related to hormone dosage when the two treatments are given separately in different periods, independently of the order of succession. It was concluded that thyroxine exerts a radiosensitizing action and the possible mechanisms of this action are discussed. (auth)

29350 ASSOCIATION OF CHEMIOTHERAPY (ENDOXAN) WITH PANIRRADIATION: STUDIES OF LETHAL EFFECTS IN MICE. R. Sorrentino and C. Martinenghi (Ospedale Maggiore, Novara, Italy and Università, Milan). Radiobiol. Latina, 6: 119-26(Apr.-June 1963). (In Italian)

The mortality of rats treated by panirradiation with 50% lethal dosage and treated at the same time with an antiblastic (Endoxan) was higher than that of controls treated by the same dosage of panirradiation alone. The same dosage of Endoxan given to a group of controls did not show any lethal effects and was well tolerated. Although the experiment was carried out on small groups of animals (30 animals per group) the results suggested consideration of the time factor in the associated radiation-chemiotherapy. (auth)

29351 THE QUESTION OF CHANGES IN THE URINARY SYSTEM AFTER IRRADIATION OF THE ABDOMINAL REGION. A. Morczek and W. Schmidt (Medizinische Akademie, Magdeburg, Ger.). Radiobiol. Radiotherap., 5: 315-20(1964). (In German)

Morphological and functional changes in the urinary system are one of the most important complications in the irradiation of genital carcinomas. It was demonstrated that a number of patients showed congestions of the urinary flow before beginning the radiation therapy. A later occurrence or increase of congestion was always accompanied with tumor growth and repeated irradiation. The effects of both components in the formation of complications could not be differentiated. (auth)

29352 MORPHOLOGICAL CHANGES IN ENDOTHELIUM OF THE GREAT ARTERIAL TRUNKS OF THORAX FOLLOWING LOCAL X-RAY, BETATRON AND GAMMA IRRADIATION. H. A. Hackensellner, J. Kunz, and W. Degner (Humbolt-Universität, Berlin). Radiobiol. Radiotherap., 5: 321-31(1964). (In German)

Single thorax irradiation of 20 rabbits with conventional x irradiation, cobalt-60 gamma radiation, and high energy electrons of 17.3 Mev (2000 to 10,000 r, survival time up to 5 months after beginning of the experiment) led to diffuse disturbances of texture as well as to severe focal cellular and nuclear changes of endothelium of the great arterial trunks. An unequivocal dose dependence of these changes was not to be demonstrated. The focal endothelial changes were from their morphological peculiarities and their increased occurrence after an interval of one month, interpreted as centers of pathological regeneration. Apart from a somewhat increased lethality of the x-irradiated animals there were no differences in the effect of the three radiation qualities used; especially there were no qualitatively or quantitatively different endothelial lesions. (auth)

29353 CHANGES TAKING PLACE ON X-IRRADIATION AND NITROGEN-MUSTARD POISONING IN THE GLYCOGEN CONTENT OF THE LIVER AND IN THE STRUCTURE OF THE MOLECULE OF THE LIVER-GLYCOGEN. D. Tanka, G. Dávid, and A. Czuppon (National Inst. for Rheumatism and Medical Hydrology and Hungarian Academy of Sciences for Structural Chemistry, Budapest). Radiobiol. Radiotherap., 5: 365-71(1964).

Histochemical and chemical methods were used to examine the glycogen content of the livers of rats in radiation disease and nitrogen-mustard poisoning. The PAS-positivity of liver sections fixed in formalin disappears 24 to 48 hours after irradiation and nitrogen-mustard poisoning and often failed to return to the normal in 30 days. The chemical investigations showed, that 48 to 120 hours after irradiation or poisoning, the glycogen content of the liver was reduced in a considerable part of the animals, being normalized to a significant extent after 240 hours. The PAS-positivity of the livers fixed in alcohol saturated with glucose showed parallelism with the chemical determinations. It was concluded that in a watery (formalin) fixer the glycogen molecules of low polymerity are dissolved, whereas in alcohol fixer they are not. The change taking place in the structure of the glycogen molecules was proved by viscosimetric and ultracentrifugal measurements. (auth)

29354 THE FREQUENCY OF DICENTRICS IN HUMAN LEUKOCYTES IRRADIATED IN VIVO AND IN VITRO. Amos Norman, Richard E. Ottoman, Motomichi Sasaki, and Robert C. Veomett (Univ. of California, Los Angeles). Radiology, 83: 108-10(July 1964).

The frequency of dicentric chromosome production in irradiated leukocytes is directly proportional to the square of the dose. Also, it appears to be independent of the x ray energy level and of the dose rate in vitro. The results indicate that the frequency induced in vivo can be a factor of two higher or lower than the frequency in vitro for the same dose of radiation. (auth)

29355 RADIATION EFFECTS ON CELL CYCLE DYNAMICS. Frank R. Hendrickson and George G. Hibbs (Presbyterian-St. Luke's Hospital, Chicago). Radiology, 83: 131-40(July 1964).

Cell radiosensitivity varies markedly in different portions of the cell's life cycle. In tissue culture systems following an initial exposure of ionizing radiation, there is a considerable fluctuation in radiation sensitivity. This is probably a function both of repair of sublethal damage and of progression around the cell cycle with accumulation of cells in a more sensitive phase. After irradiation, the number of cells observed in "S" differs significantly between those in tissue culture and those in in vivo systems. Since both systems have similar cell-generation times, further studies of this postirradiation phase in each are indicated. Double-label technics with tritium- and carbon-labeled thymidine appear to be one method by which more information may be achieved in any randomly dividing system. While these and other studies have tended to emphasize the possible relation of the DNA synthesis period to radiation sensitivity, there is little experimental evidence to conclude a cause-and-effect relation. It is, rather, our ignorance of the intermitotic period and its multiple biologic functions that limits study to effects related to the "S" period. DNA synthesis is merely a convenient marker of the mid-intermitosis period. Variation in radiation sensitivity around the cell cycle in different cell types could be a function of the cell type or could be a factor common in all but unrelated even in time to DNA synthesis. (auth)

29356 CARCINOGENESIS. I. THE MAIN THEORIES. G. Mathe (Hôpital Saint Louis, Paris). Rev. Praticien, 13: 1067-75(Apr. 1, 1963). (In French)

Physical, chemical, and biological carcinogens, including ionizing radiations, and their mode of action are reviewed.

29357 VARIATIONS OF SOME TPN-DEPENDENT DEHYDROGENASE ACTIVITIES IN HEPATIC TISSUE OF THE TOTALLY IRRADIATED RAT. Gaspare Sanna (Ospedale Civile, Cesena, Italy). Riv. Patol. Clin., 18: 148-58(Apr. 1963). (In Italian)

The TPN-specific enzymes glucose-6-phosphate dehydrogenase, 6-phosphogluconic dehydrogenase, and isocitric dehydrogenase were studied in totally irradiated rats by spectrophotometric measurement of the coenzyme at 340 mμ using previously described techniques. Total liver homogenates were prepared, and the activity reported as $\Delta E_{340} \cdot 10^3/(\text{min} \cdot \text{mg protein})$. The activities of glucose-6-phosphate dehydrogenase, 6-phosphogluconic dehydrogenase, and isocitric dehydrogenase were found to have respective mean values as follows: control animals: 4.64, 8.03, 179.44. Irradiated (400 r) animals, after 24 hrs: 4.61, 7.87, 160.45; after 48 hr: 4.58, 7.95, 166.26; after ten days: 4.71, 8.72, 219.15; after 20 days: 4.26, 7.80, 173.60. Irradiated (800 r) animals, after 24 hr: 4.74, 8.58, 202.76; after 48 hr, 5.44, 8.65, 210.72; after 96 hr, 5.83, 8.85, 243.43. It is suggested that one cause of this slight decrease after 48 hr with 400 r may be a diminution of synthesis of enzymes on irradiation; after 10 days there is an approach toward normal function. Other explanations are considered. In the case of the greatly increased enzymatic activity after irradiation with 800 r, it is suggested that this reflects the disturbance of osmotic equilibria in the irradiated cell or disturbance of the various cellular parts in which each enzyme is found. (BBB)

29358 RADIOSENSITIVITY OF NEW GROWTHS AND THE FACTORS INFLUENCING IT. G. Baroncelli. Riv. Radiol., 3: 702-35(1963).

The response of a tumor to ionizing radiations may be influenced by manifold factors, often still imperfectly known and linked to the nature and to the mode of administration of the radiations, and to local and general factors. Within the first group of factors influencing the radiosensitivity of experimental tumors of animals, an outstanding role is played by the distribution of the dose in time, and by the energy and the wavelength of the radiations. In general it is thought that a given dose is the more effective the shorter the time of its administration, and that the radiations of different energy do not differ substantially among themselves as far as the RBE is concerned. Among the local radiosensitivity factors one has to distinguish cellular factors, among which a noticeable significance is given to the chromosomic constitution, to the mitotic rhythm, and to the metabolic activity of the cells, and factors linked to the physical-chemical constitution of the environment such as pH, hydration state, temperature, oxygenation, vascularization, volume and tumoral bed, and artificial changes of the environment due to addition of chemical substances. Among the general factors, an important role is played by age, nutritional state, and general resistance of the patient affected by the tumor. The radiosensitivity may be artificially influenced by measures aiming to modify, in the general way, the host-organism such as pan-irradiation, hormones administration, administration of chemical substances with radiosensitizing or radioprotecting action. A possible immunological host-tumor incompatibility may influence the radiosensitivity of transplantable tumors. (Excerpta Med., Sect. XXIII, 1: No. 2, (Feb. 1964)).

29359 DEPRESSION OF ERYTHROPOIESIS BY LOCAL IRRADIATION OF THE SPLEEN. II. TRANSMISSION OF THE SPLENIC ANTIMITOTIC FACTOR IN THE RABBIT. P. A. Maurice and A. Jeanrenaud (Policlinique Universitaire de Medecine, Geneva). Schweiz. Med. Wochschr., 93: 1492-4(Oct. 19, 1963). (In French)

A study was undertaken to investigate the possible antimitotic action of the irradiated spleen on bone marrow, and the transmission of this effect via the blood. Surgically exteriorized rabbit spleens irradiated with 300 r produced a 16% reticulocytopenia lasting 24 to 36 hr, indicating a temporary inhibition of erythropoiesis which was confirmed by the bone marrow erythroblast mitotic index determined by the stathmokinetic method with colchicine. The value for this index 24 hr following irradiation was 55% that of its original level. As experiments performed with splenectomized rabbits demonstrated that irradiation of the splenic region (stomach and pancreas) did not cause reticulocytopenia, nor depression of bone marrow mitotic activity, it was surmised that the bone marrow reaction in nonsplenectomized irradiated animals was due to a distal, indirect or secondary effect of splenic irradiation. Splenectomy performed at varying intervals following irradiation in another group of rabbits, to determine the time required for the liberation from the spleen of the antimitotic factor, showed that erythropoietic inhibition occurred, when the spleen was left in place, two hr following irradiation. An attempt was made to concentrate the factor in the spleen by blocking the venous outflow, while preserving the arterial inflow two hr after exposure of this organ to 300 r. One hour later, three hr after irradiation, the spleen was removed and its blood content extracted. After centrifugation the plasma was injected into a normal rabbit; it produced the same inhibition of bone marrow as observed, in peripheral blood, in splenically irradiated animals. This experiment was repeated six times with good reproducibility. Blood obtained from nonirradiated but similarly operated spleens was shown to be devoid of any antimitotic activity. The chemical nature of this antimitotic factor is now under investigation. (BBB)

29360 BIOLOGICAL COMPLEXITY AND RADIOSENSITIVITY. Henry S. Kaplan and Lincoln E. Moses (Stanford Univ., Palo Alto, Calif.). Science, 145: 21-5(July 3, 1964).

An analysis was made of the relation of radiosensitivity and nucleic acid content, structure, and ploidy in various cells and viruses. (C.H.)

29361 ULTRAVIOLET SENSITIVITY OF ESCHERICHIA COLI CONTAINING HEAT-INDUCIBLE λ PROPHAGES. Margaret Lieb (Univ. of Southern California, Los Angeles and Los Angeles County General Hospital, Los Angeles). Science, 145: 175-6(July 10, 1964).

The cI-t mutants of bacteriophage λ can form prophage at 36°C but cause lysis of sensitive bacteria at temperatures above 42°C. Growth of cultures at 42° to 46°C induces prophage replication and lysis in Escherichia coli K12 (λ cI-t); lysogenic strains containing wild-type prophage are not induced to lyse at these temperatures. Heat induction is prevented by chloramphenicol. Strains containing heat-inducible prophage are much more sensitive to killing by ultraviolet light than is K12 (λ+). (auth)

29362 CIRCADIAN RHYTHMICITY IN THE SENSITIVITY OF TWO STRAINS OF MICE TO WHOLE-BODY RADIATION. Donald J. Pizzarello, Daniel Isaak, Kian Eng Chua, and A. Leonard Rhyne (Bowman Gray School of Medicine, Winston-Salem, N. C.). Science, 145: 286-91 (July 17, 1964).

When male mice of the Swiss-Webster and C_3H strains were maintained on a light-dark cycle in which the light began at 7 a.m. and ended at 7 p.m., they were more sensitive to whole-body x irradiation (800 to 900 roentgens)

given at 2 a.m. than at any other time in the cycle tested. (auth)

29363 THE EFFECT OF GAMMA AND NEUTRON IRRADIATION OF SOIL ON THE YIELD AND NUTRIENT UPTAKE OF RYE. D. G. Cummins and R. A. McCreery (Georgia Experiment Station, Experiment). Soil Sci. Soc. Am. Proc., 28: 390-3(May-June 1964).

The possible effects of radiation on soil fertility were investigated. Sandy loam and sandy soils were exposed to 3 rates of mixed γ and neutron radiation after 6 fertility treatments and at two levels of moisture content. Rye was grown as a test crop on these soils in the greenhouse. Forage yield and the uptake of N, P, K, Ca, Mg, and Na by rye were used to evaluate irradiation effects. The forage yields of rye on sandy loam soil with little N was increased as a result of irradiation, probably as a result of increased mineral N from dead organisms. The uptake of other elements was not affected. No effects were noted in nutrient-rich soils. (C.H.)

29364 THE BEHAVIOR OF VARIOUS BLOOD COAGULATION FACTORS IN THE CASE OF IRRADIATION OF GYNECOLOGICAL CARCINOMAS WITH ^{60}Co. Walter Graeber (Universität, Heidelberg). Strahlentherapie, 124: 60-8(May 1964). (In German)

The influence of ionizing radiation on the blood coagulation system was investigated in 60 women with gynecological carcinoma. Intrauterine radiocobalt treatment caused an increase of the fibrinogen level; factor V and the thrombocyte count showed significant changes. Factor VII and prothrombin showed, under radiation influence, a slight decrease followed by a gradual increase. Percutaneous telecobalt irradiation caused a continuous decrease of the thrombocyte count. The fibrinogen level showed no significant reaction. There was a decrease of factor V, factor VII, and prothrombin during the first radiation period, followed by a gradual increase. (auth)

29365 COMPARATIVE INVESTIGATIONS ON THE EFFECTIVENESS OF SOME CYTOSTATISTICS AND X-RAY IRRADIATION. PART 2. HISTOLOGICAL AND CYTOLOGICAL CONDITIONS OF SPLEEN, ANTIBODY DETERMINATIONS AFTER BRUCELLA MELITENSIS ANTIGEN DOSES, AND BONE MARROW CHANGES AS A RESULT OF THE ACTION OF N- MUSTARD GAS-PHOSPHAMIDE ESTER, TRISETHYLENEIMINOBENZOQUINONE X RADIATION ALONE AND IN VARIOUS COMBINATIONS ON NORMAL WISTAR RATS. Rudolf Schneider (Universität, Marburg/Lahn, Ger.). Strahlentherapie, 124: 75-85(May 1964). (In German)

Cytological investigations were made of spleen and bone marrow along with screening antibody determinations after repeated administration of Endoxan or Trenimon and their combination with local irradiation. Comparable analyses showed that local irradiation caused the least morphological changes in hematopoietic and lymphoreticular tissue (spleen). In the case of screening antibody determinations it even caused slightly increased titers. The different side of action and the different effect of Endoxan and Trenimon could also be proven in these experimental series. The antibody titers were lower after bis-chloroethyl propylenephosphoric acid ester-diamide (Endoxan) than after trisethyleneiminobenzoquinone (Trenimon). (auth)

29366 INVESTIGATIONS ON THE BIOLOGICAL EFFECTS OF EXTREMELY HIGH DOSES. Felix Wachsmann and Djawad Kermani (Universität, Erlangen, Ger.). Strahlentherapie, 124: 86-98(May 1964). (In German)

Effects obtained by irradiating plants and animals with doses up to 12 megaroentgens are reported. The macroscopic and microscopic changes observed are described. Since radiation effects in plants occurred beyond the irradiated area and death was caused even in animals in which organs unnecessary for life were irradiated only, the presence of "radiotoxins" was assumed. (auth)

29367 OBSERVATIONS ON THE RADIORESISTANCE OF GOATS AFTER IRRADIATION. Ernst Waldschmidt-Leitz and Lorenz Keller (Heilgenberg-Instituts, Heiligenberg/Baden, Ger.). Strahlentherapie, 124: 108-13(May 1964). (In German)

It was observed that the changes in ratio and composition of the protein fractions occurring in goats after x-ray irradiation were less pronounced if irradiation was repeated after these values had returned to normal. This effect is believed to be caused by production of a resistance factor. (auth)

29368 INVESTIGATIONS ON ANIMALS WITH IMMUNITY AGAINST IONIZING RADIATION. Liebknecht Dimitrov (Universität, Sofia). Strahlentherapie, 124: 114-26(May 1964). (In German)

After irradiation with 1250 r changes in the serum protein fractions, peptidase activity, and alkaline phosphatase in serum were found in both "resistant" and control animals. They were accompanied by certain histological changes. They were the same in both of the animal groups and show only quantitative differences. In the "resistant" animals the pathological changes were reversible. The considerable quantitative difference in the observed changes offered an opportunity to give a prognosis for radiation sickness. (auth)

29369 ON THE SKIN-ERYTHEMA EFFECT OF UV FLASHES. Klauss Schmidt (Max-Planck-Institut für Biophysik, Frankfurt am Main). Strahlentherapie, 124: 127-36(May 1964). (In German)

The mathematical treatment of a general model for intensity-dependent radiation reactions is given and possible conclusions from radiation experiments with short flashes are discussed. Construction, method of action, and efficiency of an apparatus used for production of uv flashes are reported. The skin erythema effect of a monochromatic uv-irradiation with periodic flashes was investigated with this apparatus and compared with the one caused by continuing irradiation. Exact dosages were considered very important. A uv dosimeter developed for this purpose is described. There was no difference between the effects of both types of radiation within measurement accuracy. (auth)

29370 TRANSFORMATION OF AN X-RAY MATERIALS TESTING UNIT FOR ANIMAL IRRADIATION. Gunther Barth, Guenther Von Freier, Herbert Graebner, and Dietrich Ringleb (Universität, Gissen, Ger. and C.H.F. Müller GmbH, Hamburg). Strahlentherapie, 124: 137-41(May 1964). (In German)

Alteration of a materials testing unit using x rays for use as an animal irradiation unit is reported. Additional precaution measures for the selective use of 2 x-ray tubes in a closed room are described. A constant reproducible experimental design for total-body irradiation is reported. (auth)

29371 THE EFFECTS OF INHALED HEXAMETAPHOSPHATE AEROSOLS ON THE METABOLISM OF INHALED RADIOCERIUM (^{144}Ce–^{144}Pr) BY MICE. Friedrich Gensicke (Institute für Medizin und Biologie, Deutsche Akademie der Wissenschaften, Berlin). Strahlentherapie, 124: 242-53(June 1964). (In German)

The effect of sodium-hexametaphosphate-liquid aerosols

upon resorption and incorporation of inhaled radiocerium into the organs of white mice was investigated. The first aerosol treatment was done 24 hours after inhalation of $^{144}CeCl_3$-liquid aerosols and the 5th and last treatment was done on the 14th day. It was observed, that radiocerium incorporation into the lungs was diminished after each aerosol treatment. Twenty-four hours after the last treatment a decrease in activity of 51% was observed in comparison to the controls. The effect of HMP aerosols is not limited to ^{144}Ce-incorporation in the lungs but also applicable to liver, skeleton, and the other investigated organs, especially after the first few treatments. It might be concluded, that additional treatments with HMP aerosols would be successful. (auth)

29372 BIOGENIC AMINES IN URINE AND BLOOD OF RATS AFTER SUB-LETHAL WHOLE-BODY IRRADIATION. PART 3. THE INFLUENCE OF α-METHYLDOPA AND PHENYLACETIC ACID ON THE NORMALLY DECLINING APPEARANCE OF BODY AMINES AFTER WHOLE-BODY IRRADIATION. Franz Frazen, Hubert Gross, and Gerhard Friedrich (Universität, Cologne). Strahlentherapie, 124: 270-4(June 1964). (In German)

The observed increase of internal amines (tryptamine, serotonine, bufotenine, histamine, dopamine, noradrenaline, adrenaline) after total body irradiation was inhibited or reduced by a daily application of α-methyldopa and phenylacetic acid post irradiation. This effect did not prolong the survival time of the experimental animals. (auth)

29373 INVESTIGATIONS ON THE RADIOSENSITIVITY OF DESOXRIBONUCLEIC ACID. I. THE SENSITIVITY OF HYDROGEN BRIDGES. Ulrich Hagen and Reinhild Wild (Universität, Freiburg i. B.). Strahlentherapie, 124: 275-83(June 1964). (In German)

High radiations doses which decrease the molecular weight of DNA by one-tenth break 50% of the hydrogen bridges between the base pairs. This radiation induced denaturation of the DNA can be measured by means of the hyperchromic effect and the formaldehyde reaction. Both methods give the same degree of denaturation. Using a concentration of $c = 3 \times 10^{-3}$ M DNA-P, the G-value for breaking the hydrogen bridges is 3.8 to 24.1. Irradiated DNA can be denatured by heating more easily than non-irradiated DNA. The melting point of the DNA, that is the temperature which denatures 50% of the DNA, is decreased to 10°C without showing a denaturation of the DNA prior to heating. Possible mechanisms of the radiation effect on the hydrogen bridges are discussed. (auth)

29374 THE OBTAINING OF COMBINATION DAMAGE TO IRRADIATED ORGANISMS. Raimund Fridrich (Universität, Basel). Strahlentherapie, 124: 302-7(June 1964). (In German)

The increase of the survival rate of mice exposed to stress within 48 hours prior to or after a sublethal whole-body irradiation did not occur, if the animal received morphine and nembutal prior to the first stress. The explanation for this effect is based on the assumption that ionizing radiation, in regard to secondary reactions in the organism, stimulates the hypophysis-adrenal cortex-system via the hypothalamus by acting as a non-specific stressor. Therefore, during the first reaction of the system which lasts 48 hours, the organism is more resistant to a further stress. This assumption is confirmed by the fact that by administration of morphine and nembutal, which inhibit the reactivity of the hypothalamus and thus the stimulation of the hypophysis-adrenal cortex-system, the increase in resistance to a following stress does not occur. (auth)

29375 THE EFFECTS OF CHRONIC WHOLE-BODY GAMMA IRRADIATION ON THE HEMATOLOGY OF THE ALBINO RAT. George M. Krise, Dorthea T. Robinson, and Sidney O. Brown (Agriculture and Mechanical Coll. of Texas, College Station). Texas J. Sci., 13: 445-53(Dec. 1961).

The hematologic response in animals subjected to long-term, virtually continuous exposure to low-dose radiation was studied. Three groups of rats were placed in a ^{60}Co radiation chamber in positions to receive 2, 5, and 10 r per 23-hr period. The radiation facility is described in detail and illustrated. It consists of a room 30 ft^2, with the ^{60}Co assembly at the geometrical center; the assembly is comprised of two 1-C ^{60}Co sources separated by a distance of 6 ft. Thus a two-point source was used, around which concentric circles of cage racks were placed. At the end of 50 weeks the accumulated whole-body doses received by the various exposure groups were: 2-r group, 700 r; 5-r group, 1750 r; and 10-r group, 3500 r. A difference in weight increment was noted between male and female animals. The young males exposed to 10 r/day gained significantly less than the controls from the thirtieth to fiftieth week. No similar decrease was observed in young females similarly exposed. The total peripheral white blood cell counts of all animals exposed to γ irradiation decreased with increasing accumulated dose in the expected order of response, $10 r < 5 r < 2 r < 0$. Total white blood cell counts of the irradiated males declined significantly more than did the white counts of similarly irradiated females. Differential white blood cell counts indicated that the only significantly depressed elements were the lymphocytes. The decline in circulating lymphocytes paralleled that of the total white blood cell count with a similar difference between sexes. Even though the data for the 2-r/day exposures were not statistically significant, there was a trend suggesting that continuing the exposures would lead to eventual change similar to that of the animals exposed to 5 and 10 r per day. (BBB)

29376 MODIFICATIONS OF THE PERMEABILITY OF THE BLOOD-LABYRINTH BARRIER TO FLUORESCEIN IN THE IRRADIATED ANIMAL. P. Bonaccorsi, C. Jucker, and G. Sambuco (Università, Pavia, Italy). Valsalva, 38: 259-66(Oct. 1962). (In Italian)

Adult rabbits were immobilized and irradiated totally except for the head, which was protected by a lead shield in order to prevent direct action of x rays on the ear. Sodium fluorescein was injected intravenously (100 mg/kg) after the irradiation, and the animals were sacrificed 1 hr after injection. Doses used were: 400 r, 300 r, and 200 r. Fluorescein was introduced 1, 12, 24, and 48 hr after irradiation. Samples of labyrinth fluid were taken by the method of Alfred, Hallpike, and Ledoux, and the fluorescence of these samples was compared with samples of known dilution to give semi-quantitative results. Irradiation with sublethal doses produced an increase in the permeability of the blood-labyrinth barrier to fluorescein. Various hypotheses for the explanation of this phenomenon are briefly considered. (BBB)

29377 MORPHOLOGICAL CHANGES IN MAMMALIAN CELLS GROWN IN CULTURE INDUCED BY X-RAYS. B. Miletic, D. Petrovic, A. Han, and B. Brdar (Inst. "Ruder Boskovic," Zagreb). Vojnosanit. Pregled, 20: 415-19 (July 1963). (In Serbian)

The action of 500- to 200-r doses of 230-kv x irradiation on cultured L cells (mice fibroblasts) with regard to morphologic changes was analyzed. Nonspecific degenerative changes and frequent appearance of giant cells were observed. These phenomena were described earlier

by other authors studying other cell strains. In cells proliferating from one surviving irradiated cell various degenerative changes appeared. (BBB)

29378 THE INTRACELLULAR DISTRIBUTION OF DIPHOSPHOPYRIDINE NUCLEOTIDE IN TUMOR CELLS AFTER X IRRADIATION. W. Schmack (Universität, Bonn), H. Maass and G. Locher. Z. Krebsforsch., 65: 257-60 (Mar. 30, 1963). (In German)

Experiments were conducted on Yoshida ascites sarcoma cells to determine whether changes in cellular concentrations of coenzyme are involved in the observed depression of glycolysis in irradiated cells. The cells were x irradiated with 25,000-r doses aerobically at room temperature and then incubated with or without glucose anaerobically for 10 or 60 min. The cells were homogenized and the homogenate centrifuged at 40,000 g for 60 min to separate the supernatant cytoplasmic fraction from the sediment composed of nuclei, mitochondria, and large microsomes. The diphosphopyridine nucleotide (DPN) concentration was reduced in both of these fractions in irradiated cells compared with normal cells, but to a greater degree in the supernatant cytoplasmic fraction. DPN content of the cytoplasmic fraction of the irradiated cells was less than $\frac{1}{3}$ that of control cells; however, 60 min after incubation with glucose it rose 27% (to within 40% of the value in control cells) compared with only an 8% rise in control cells incubated with glucose. The total DPN content of irradiated cells was also decreased when contrasted with that of unirradiated cells. These results help explain the previous finding that addition of pyruvate to irradiated cells tended to normalize the depressed glycolysis rate. This may result from an increase in cytoplasmic DPN and in inorganic phosphate; both substances would stimulate triosephosphate dehydrogenase activity, one of the primary reactions inhibited by irradiation. (BBB)

29379 RADIATSIONNYE PORAZHENIYA KOSTNOI SISTEMY. (Radiation Injuries to Bone Structure). N. N. Litvinov. Moscow, Medzig, 1964. 236p.

Injuries to the skeleton from internal and external irradiation are considered. General questions of the physiology and pathology of bone tissue are examined. Changes in the bone structure and regeneration of bone tissue after external irradiation are described. Injuries from internal exposure, radioisotope distribution in the skeleton, and tissue regeneration are covered. Bone tumors from internal and external irradiation are discussed. (M.J.T.)

29380 BIOKHIMIYA MALYKH DOZ IONIZIRUYUSHCHEI RADIATSII. (Biochemistry of Small Doses of Ionizing Radiation). L. S. Cherkasovoi, ed. Minsk, Izdatel'stvo Nauka i Tekhnika, 1964. 165p.

The question of the action of small doses of ionizing radiation on the exchange of material in a living organism is treated. Results of experimental investigations and data from the literature, particularly on the effects of x rays on biochemical processes, are summarized. Consideration is given to changes, during the first hour and at later times after irradiation, in respiration metabolism and in catabolism and anabolism of proteins, carbohydrates, and high-energy phosphorus-containing compounds in the central nervous system, liver, muscle, and other tissues. (M.J.T.)

29381 RADIATION AND IMMUNE MECHANISMS. William H. Taliaferro, Lucy Graves Taliaferro, and Bernard N. Jaroslow (Argonne National Lab., Ill.). American Institute of Biological Sciences and U. S. Atomic Energy Commission Monograph Series on Radiation Biology. New York, Academic Press, 1964. 165p.

The humoral and cellular phases of ingrate and acquired immune mechanisms and the effects of whole-body exposure to x or γ radiation on these mechanisms are discussed. It is pointed out that the desirable actions of immune mechanisms, such as those that overcome or prevent disease, are largely associated with the fact that they are sensitive to proteins from invaders or other objects that have entered the body. At the same time, these mechanisms can be the basis for distributing afflictions, such as hay fever, and this same intolerance of foreign proteins also interferes with successful organ transplantation. Topics discussed in detail include antigen-antibody reactions; the diversity and measurement of antibodies; the immune response; the radioresistance of the antibody molecule; radioinduced changes in primary antibody response as related to biochemical and cellular phases; radioinduced changes in primary antibody response as related to species, antigen dosage, and radiation dose; radioinduced changes in the secondary antibody response; protection and restoration of antibody synthesis in irradiated animals; radiation effects, protection, and restorative procedures for innate antibodies; the effects of radiation on immunological tolerance; radiation effects on homograft rejection; radiation effects on cells and systems involved in immune reactions; radioinduced changes in the course of infection; and the effects of radiomimetic substances on antibody formation. (320 references). (C.H.)

29382 VOPROSY PATOARKHITEKTONIKI LUCHEVOGO PORAZHENIYA. (Questions of Pathoarchitectonics of Radiation Sickness). A. D. Zurabashvili and B. R. Naneishvili. Tbilisi, USSR, State Publishing House of the Academy of Sciences Gruzinskoi SSR, 1962. 129p.

Radiation effects on the central nervous system of 4 macacus rhesus monkeys and 23 adult dogs were studied experimentally. Total or fractionated doses of 500 to 2000 r of x radiation, cobalt-60 gamma radiation, or fast neutrons were given. Parts of the central nervous system—horns, cerebellum, optic lobes, spinal bulb, and spinal cord—were studied from histopathological, cytoarchitectonical, and pathosynapsoarchitectonical points of view, using biochemical tests. Results indicate that the central nervous system is not highly radiation resistant, contrary to previous ideas. (M.J.T.)

29383 BONE MARROW LYMPHOCYTES OF THE RAT AND GUINEA PIG. N. B. Everett, Ruth W. Caffrey, David Adams, and D. G. Osmond (Univ. of Washington, St. Louis; Univ. of Edinburgh; and Univ. of Bristol, Eng.). 4p. (CONF-500-3)

From Conference on Radiation Protection and Recovery, Oak Ridge, Tenn., Nov. 1963.

Recent observations are reviewed which suggest that bone marrow lymphocytes have their origin in marrow and, like the cells of the thymus, have a rapid turnover rate (3 to 5 days), i.e., they belong to the short-lived population of small lymphocytes. In contrast, the majority of the small lymphocytes of lymph nodes and of thoracic duct lymph have a long life span. (auth)

Radiation Effects Therapy and Countermeasures

29384 ON CHEMICAL AND BIOLOGICAL PROTECTION AGAINST RADIATION INJURY. II. EFFECTS OF ADMINISTRATION OF PROPERDIN ON CHRONIC X-RAY

INJURY. V. Diomede-Fresa and G. Del Buono (Università, Bari, Italy). Accad. Pugliese Sci., Atti Relaz., Pt. 2, (N.S.), 18: 267-74(1960). (In Italian)

A previous study (15: 22175) showed that intravenous injection of purified properdin (25 units/kg) conferred marked protection on rabbits submitted to 2000-r, whole-body x irradiation, half of the animals surviving beyond the 192nd hour compared with only the 3rd hour in controls. As a follow-up on these acute irradiation experiments, similar studies were conducted in chronically irradiated rabbits, receiving daily 100-r, whole-body doses of 180-kv x rays until death. The rabbits were given daily intravenous doses (25 units/kg body weight) of a commercial preparation (Merck) of purified properdin. In the uninjected animals the serum levels of properdin fell progressively after irradiation from a control level of 22.6 units/ml to 5.3 on the fourth day and to 2.8 units/ml on the eighth day. All of these control rabbits had expired by the 22nd day. In contrast, the last properdin-treated, x-irradiated rabbit survived until the 43rd day of daily 100-r irradiation, and the serum properdin levels remained higher in this group than in the controls. The initial, four-day, and eight-day levels were 24, 8.5, and 5.6 units/ml, respectively. It is concluded that exogenous properdin confers significant protection on irradiated animals, presumably on account of its nonspecific antibacterial activity. (BBB)

29385 CUTANEOUS RADIONECROSIS. J. Vrebos. Acta Chir. Belg., 62: 517-32(May 1963). (In French)

Treatment of five cases of radiation necrosis by plastic surgery is described, and the two forms of chronic radiation dermititis occurring as a consequence of overexposure to ionizing radiations are discussed. In the first type, dermatitis develops progressively into ulceration. In the second type, seen in the cases described here, radiation necrosis erupts suddenly, months or years after exposure, following irritation, a bruise, or infection. Many factors are involved in its causation, such as quantity and quality of radiation, repetition of irradiation, anatomic predisposition, and vascular impairment. Treatment is described. The proper uses of radiation are discussed, including measures for the prevention of cutaneous radiation necrosis. (BBB)

29386 RADIATION RECOVERY IN MAN: A CLINICAL EVALUATION OF THE PROBLEM. Robert van Hoek and Carl L. Hansen, Jr. (National Inst. of Health, Bethesda, Md.). Aerospace Med., 35: 383-5(Apr. 1964).

An analysis of available experimental data, with respect to acute radiation injury and casualty estimation, shows that there is insufficient information to support a detailed listing of clinical signs and symptoms, morbidity, or mortality vs radiation dose, and no reliable factor for extrapolating animal data to man. Human clinical experience permits only a limited prediction of the radiation response in man, and then a measure of reliability, in terms of both the physical and biological parameters, exists only for the response to single, sublethal doses. Fallacies of human calculating in radiation injury and recovery from experimental data are discussed. (BBB)

29387 ON METABOLIC DIFFERENCES BETWEEN THE TISSUES OF COLD- AND WARM-BLOODED ANIMALS (AND A CONTRIBUTION TO THE QUESTION: POIKILOTHERMISM A RADIOPROTECTANT?). A. Locker (Oesterreichische Studiengesellschaft fur Atomenergie, Vienna). Arch. Ges. Physiol., 275: 238-55(1962). (In German)

Metabolic differences between the tissues of a poikilothermic animal (frog) and a homothermic animal (mouse) were studied in attempts to elucidate the previous finding that amphibians and reptiles (poikilothermic animals) are less sensitive to the lethal effects of ionizing radiations than birds and mammals (homothermic animals). Thus it was found that some cold-blooded species can withstand 3 to 10 times greater x-ray doses than mammals at equivalent mortality rates and survival times. Respiration of frog brain, skeletal muscle, heart, kidney, liver, spleen, and skin was examined over the temperature range 12.5 to 42.5°C under the influence of various concentrations of 4,6-dinitro-o-cresol, a metabolic inhibitor. Similar experiments were conducted on mouse tissue, except for skin. The percentage by which this inhibitor decreased the respiration rate of frog brain, liver, and heart increased with increasing temperature, whereas in the other frog tissues and all the mouse tissues it decreased with increasing temperature. The difference between the frog and mouse was significant with brain and liver. This finding is discussed in terms of the theory that the principal metabolic differences between cold- and warm-blooded animals reside in the temperature dependence of their energy-yielding and energy-utilizing reactions. A comparison of the O_2-consumption vs temperature curves of frog and mouse tissues showed that the maximum activity of frog tissues is reached 7.5 to 17.5° (average 10°C) below that of mouse tissues. It is suggested that if warm-blooded animals were cooled to about 10° below their normal body temperature, they would show the same radiation resistance as cold-blooded animals. (BBB)

29388 THORIUM X-INDUCED BASAL-CELL CARCINOMA: A CASE REPORT. A. D. Courtemanche (Shaughnessy Hospital, Vancouver, Can.). Brit. J. Plastic Surg., 14: 254-7(Oct. 1961).

The case history is reported of a 16-yr-old boy, who, 9 yr after treatment of a port-wine stain with Th X, developed a basal-cell carcinoma at the site of application. He had received repeated Th X and carbon dioxide snow applications to a large stain on his right lower eyelid and cheek, but there was no obvious improvement. Nine yr later when the lesion was examined, its surface was nodular and there appeared to be an underlying cavernous element. Under general anesthesia the hemangioma was completely excised, and the resulting defect was covered with a graft from the posterior aspect of his right thigh. This case suggests that the treatment of skin conditions with Th X solution is not as innocuous a procedure as generally believed, although the occurrence of basal-cell carcinoma following Th X application must be extremely rare in view of its widespread use. Two skin malignancies, both on the lower eyelid, have previously been reported, but these differ in that Thorotrast was used to visualize the lacrymal ducts. (BBB)

29389 RADIATION HAZARDS. T. W. Wikramanayake (Univ. of Ceylon, Peradeniya). Ceylon Med. J., 6: 27-31 (July 1961).

The somatic and genetic effects of ionizing radiations on humans are reviewed, with comparison to the effects of other injurious physical and chemical agents. Problems encountered in the increasing medical uses of radioisotopes are discussed and it is suggested that radioiodine and phosphorus when used therapeutically may become a danger to the general population if sufficient isotope is allowed to contaminate food or drinking water. Fallout radiation hazards are considered, and radiation problems, in general, encountered by a developing nation are men-

tioned, along with recommendations for their successful handling. (BBB)

29390 ENVIRONMENTAL AND OCCUPATIONAL CANCER HAZARDS. W. C. Hueper (National Cancer Inst., Bethesda, Md.). Clin. Pharmacol. Therap., 3: 776-813 (Nov.-Dec. 1962).

The carcinogenic actions of chemical and physical agents are extensively reviewed. It is pointed out that among the numerous exogenous carcinogens examined, ionizing radiation is the only universal carcinogen, capable of producing cancer in all species tested so far. The reported appearance of cancer involving the skin or the blood-forming tissures after a single and relatively brief exposure to ionizing radiation seems to favor the chemical theory of radiation carcinogenesis since the circumstances accompanying the response resemble closely those seen in chemical carcinogenesis associated with a depot effect from a carcinogen. The ability of various radioactive materials to cause lung cancer, particularly in miners, is discussed. Human and animal evidence obtained mainly during the last decade has established that a causal relation exists between leukemia and exposure to radium, Thorotrast, occupational and therapeutic x rays, and radionuclides generated during the explosion of atomic bombs. (BBB)

29391 SEROTONIN AND LOCAL EFFECTS OF X RAYS. 5. APPLICATION OF SEROTONIN IONOTOPHORETICALLY IN THE GUINEA PIG. A. Maggiora (Clinique Universitaire de Dermatologie, Geneva). Dermatologica, 127: 398-402(1963). (In French)

An attempt was made to introduce serotonin by ionotophoresis so as to determine whether the radioprotective effect is a local one. Twenty male guinea pigs were subjected to ionotophoresis for 20 min, during which time one electrode was placed over cotton soaked in a solution (5 mg/2.5 ml water) of serotonin creatinine sulfate solution applied to the animals' left flank and the other electrode soaked in physiologic saline to the right hind leg. Twenty min later the animals were immediately subjected to local x irradiation of 800 r in the region of the applied electrode and irradiated also on the right flank. A second group of ionotophorized animals were irradiated under the same conditions following a time lapse of 5 min instead of immediately. Contrary to expectations the results showed that protection against the depilatory effect of x rays was greatest on the side not subjected to serotonin ionotophoresis. Animals irradiated after a 5 min interval showed less depilation than in the immediately irradiated group. Serotonin is presumably rapidly distributed by the blood stream to the skin. (BBB)

29392 GASTROINTESTINAL TRACT TUMORS INDUCED BY RADIOCERIUM (Ce^{144}). G. A. Lebedeva. Federation Proc., Transl. Suppl., 23: T526-8(May-June 1964). (Translated from Arkh. Patol., 25: 40(1963)).

Tumors arising in the gastrointestinal tract of rats following introduction into the stomach of 9 to 18 $\mu c/g$ of ^{144}Ce are described. Tumors were demonstrated 250 to 485 days after the start of the experiment and histologically were adenomas, papillomas, leiomyomas sarcomas, and squamous cell, mucoid, diffuse, and solid cancers and adenocarcinomas. The most common site of tumor development was the large intestine, as this part of the gastrointestinal tract received the greatest dose of radiation. (auth)

29393 PREVENTION AND TREATMENT OF ACUTE RADIATION SICKNESS IN DOGS WITH SODIUM GALLATE. O. O. Horodets'kii and V. A. Baraboi (Bogomolets Inst. of Physiology, Kiev). Federation Proc., Transl. Suppl., 23: Pt. II T531-2(May 1964). Translated from Fiziol. Zh., Akad. Nauk Ukr. RSR, 9: 240(1963).

Intravenous injection of sodium gallate into dogs 30 min before irradiation with 600 r assisted three of five animals to survive and increased the lifespan of dogs that died by an average of 7 to 10 days. Administration of sodium gallate to dogs immediately after exposure to 600 r also resulted in the survival of three of seven dogs and prolonged the life of dogs that died by an average of 6 days. The antiradiation effect of sodium gallate administered before or after irradiation improves the clinical course of radiation sickness by postponing the climax of the sickness 4 to 8 days or more. The results from experiments on dogs are in agreement with those of previous experiments and indicate the advisability of clinically testing sodium gallate as an antiradiation remedy. (auth)

29394 ON POSSIBLE SEQUELAE OF PERMANENT EPILATION WITH THE CONTACT RADIATION METHOD. Carl Georg Schirren (Universität, Munich). Hautarzt, 13: 259-61(June 1962). (In German)

A patient who had been exposed about the face to 2000 to 4000 r of x radiation per yr, in single doses of from 500 to 2000 r from 1944 to 1949 showed evidence of radiation injury to the face and jaw. This consisted of skin atrophy, areas of depigmentation and hyperpigmentation, telangiectasis, and loss of subcutaneous fat. In some areas the skin appeared to be directly apposed to the bone. On one side of the jaw there was a fistula that extended down to the bone and on the other side there was an ulcer the size of a pea. No hair was visible in the affected skin areas, but there was clear evidence of shaven hair stumps in the remainder of the facial area. Histologic study did not show evidence of any malignant processes, but there was ample evidence for sclerotic changes of the connective tissue and fibrotic thickening of the vascular walls, sometimes with complete obliteration. The skin changes were more severe the less the radiation had been fractionated, and the closer the radiation was given over areas where the skin was in close contact with bone. It was necessary to perform a skin graft to correct the fistular bone process. It is not possible to obtain permanent epilation without producing cosmetic skin changes. The amounts of radiation used in this case were as much as twice the amount ordinarily used for the single treatment dose for skin carcinoma. Permanent epilation should never be carried out by the contact radiation method or by the soft radiation method. (BBB)

29395 LEUKEMIA AS A RADIOINDUCED DELAYED INJURY. Hans-Joachim Melching (Universität, Freiburg i. B.). Hippokrates (Stuttgart), 34: 96-101(Feb. 15, 1963). (In German)

Exposure to radiation has a positive correlation with increased leukemia incidence. Whole-body radiation increases the frequency of spontaneous leukemia, but there does not seem to be a form of leukemia that is specifically radioinduced. There is no direct linear relation between radiation and leukemia, except when a single large dose is given or when fractionated small doses are given within a short time interval. There is some relation between the magnitude of the dose energy and leukemogenic effect of high energy radiation. Local radiation has less effect than whole-body radiation, but the dose to the bone marrow is important. Leukemia is found more frequently in women than in men in Hiroshima and Nagasaki. Similar observations were noted for animals after atomic explosions, when lower doses are required to induce thymic leukosis in fe-

males. Castration of males and sustained estrogen treatment favors thymic leukosis, while castration of females or testosterone treatment has an inhibiting effect. In humans, studies indicate that there has been a slight shift of the latent period from 5 or 7 years to 8 or 12 years. Radioprotective chemical agents such as aminoethylisothiuronium or reserpine, or splenectomy, can sometimes extend survival rates. Some evidence indicates that disturbances of trypophan metabolism may be leukemogenic. The risk of induction of leukemia by x ray or other radiation therapy measures used by the physician seems small, and can be reduced to a negligible factor if proper precautions are taken by the physician to avoid excessive radiation exposure. (BBB)

29396 DEFICIENT GROWTH OF C57BL MARROW CELLS TRANSPLANTED IN F_1 HYBRID MICE: ASSOCIATION WITH THE HISTOCOMPATIBILITY-2 LOCUS. G. Cudkowicz and J. H. Stimpfling (Oak Ridge National Lab., Tenn.). Immunology, 7: 291-306(May 1964).

A study was undertaken to explore whether bone marrow cells of C57BL mouse donors which presumably would not be engaged in antibody production would grow poorly in F_1 hybrids, and to establish whethre or not deficient growth of C57BL hemopoietic cells in F_1 hybrids resulted from the effect of gene interaction or of recessive genetic determinants not expressed in the F_1 progeny from crosses between C57BL and other inbred mouse strains. The ability of C57BL, C3H, and A strain marrow cells to proliferate on transplantation into x-irradiated (700 r) isogenic, F_1 hybrid, and backcross progeny mice were investigated by the spleen-colony technique and by measuring the newly formed DNA in the recipient spleen with ^{131}I-labeled 5-iododeoxyuridine. Transplants of C57BL cells grew poorly in (A × C57BL)F_1 and in (C57BL × C3H)F_1 and reciprocal hybrids, as compared with isogenic and allogenic hosts; whereas C3H and A strain marrow grafts were successful in isogenic, F_1 hybrid and backcross recipients. In segregating backcross progeny, in offspring from F_1 hybrid females mated to C57BL males, the frequency of success or failure of the C57BL grafts suggested that the trait was controlled by a single pair of genetic determinants at an autosomal locus. The latter is apparently linked with, or part of, the H-2 region in the IXth linkage group. The results suggested also that the failure of C57BL hemopoietic cell grafts in H-2 heterozygotes was not related to exhaustion of donor cells by excess of recipient isoantigen, but rather to lack of expression in the heterozygotes of histocompatibility-related growth requirements yet undefined. These requirements are specific for hemopoietic cells, but not for skin grafts, and resulted most probably from the effect of genetic (interallelic) interaction involving H-2 or an H-2-linked locus. (BBB)

29397 RADIODERMATITIS DUE TO EXPOSURE IN INDUSTRY. Kenneth H. Burdick and Floro Miraldi (Cleveland Clinic Foundation). J. Am. Med. Assoc., 188: 607-8 (May 11, 1964).

A single case of chronic radiodermitis that occurred on the hand of a man who changed samples in an x-ray-diffraction unit is described. Laboratory conditions contributory to genesis of the disorder are reviewed. Nonmedical radiation installations in Ohio are tabulated and analyzed by category of use. (TCO)

29398 EXPERIMENTAL AND THEORETICAL ASPECTS OF SEVERE TRAUMA. William H. Moncrief, Jr. (Army Medical Corps). J. Bone Joint Surg., 44A: 747-52 (June 1962).

The complex injury that results from the blast, heat, and ionizing radiation of nuclear detonations is discussed with particular reference to data from Japanese survivors. The data show the remarkable synergism between some forms of trauma and whole-body radiation, particularly in those burned. Two facts are prominent: of the large number of casualties from burns, most were due to thermal radiation (flash burn); an inordinately large number of burned patients subsequently died. Lab studies of moderate burns and sublethal levels of radiation show a more than additive, almost synergistic, effect between mild to moderate burns (2 to 20% body-surface area) and sublethal levels of whole-body irradiation. In addition to the greater long-term mortality in compound-injured animals there is a significantly greater mortality in the first 48 hr. The synergistic effect appears to be related to bone marrow depression. Topical and parenteral administration of antibiotics is successful in reducing late mortality in experimental animals, providing the organisms are antibiotic-sensitive. It is concluded that the effects of nuclear weapons have not only compounded problems faced in the past but have forced tactical changes in military science that will undoubtedly pose new problems. (BBB)

29399 EFFECTS OF X RAYS AND NITROGEN MUSTARD ON DNA SYNTHESIS AND MITOSIS. Nirmal K. Das (Univ. of California, Berkeley). J. Cellular Comp. Physiol., 62: 146-8(Oct. 1963).

The effects of x rays and nitrogen mustard (HN2) on the cell cycle in onion root meristems, especially on DNA synthesis and mitosis, are reported. The rate of DNA synthesis was determined by silver grain counts, after ^{3}H-thymidine incorporation, and also by photometric DNA measurements in the same individual nuclei. In roots exposed to 800 r (50 r/min) a strong mitotic block was observed within one hr after irradiation, while a 16-min treatment with HN2 (2.6×10^{-4}M) produces a similar effect only about 4 to 5 hr later (the G2 phase in this material is about 4 hr). Thus, cells which were in the G2 at the time of treatment are blocked by x rays, but not by HN2, from entering into mitosis. The inability of HN2 to cause an immediate G2 delay may be related to the fact that this agent, in contrast to x rays, produces little or no chromosomal breakage in G2 cells. The rate of DNA synthesis is stimulated in cells while they are irradiated, an effect detected in the same individual nuclei by ^{3}H-thymidine incorporation as well as by photometric Feulgen DNA measurements, and a similar stimulation of DNA synthesis is found in root tip cells exposed for 16 min to HN2. The stimulatory effect of x rays or HN2 is especially strong in cells during the early S phase. Similar results were obtained in ascites tumor cells and in macronuclei of Tetrahymena pyriformis, which were sampled immediately after exposure to x rays. The question of how this stimulatory effect on DNA synthesis is brought about is discussed. One possibility suggested is that the direct damage caused by x rays or by HN2 on the DNA molecule may produce primer sites (by breaking or opening the double helix) in chromosome regions in which synthesis has not yet normally started. This assumption explains why cells in the beginning of the S phase are more affected than those at later stages of S. The stimulatory effect on DNA synthesis in the S phase cells is a temporary one. By photometric DNA measurements it was found that cells which were in the S phase at the time of irradiation with 800 r had progressed at a normal rate toward the G2 phase (or the 4C level) four hr later. On the other hand, HN2 treatment during the S phase severely impaired the further progress of such cells toward the 4C level; this

delayed effect on DNA synthesis may be an indirect one, perhaps on various enzyme systems. (BBB)

29400 RECENT ADVANCES IN CHEMICAL PROTECTION AGAINST RADIATION INJURY. H. A. S. Van Den Brenk (Cancer Inst. Board, Melbourne). J. Coll. Radiologist Australasia, 7: 222-6(Oct. 1963).

This review considers chemical protection of mammals and mammalian tissues, with particular regard to discovery of new compounds and groups of compounds, and mechanisms of action. Several original unpublished experiments are also reported. The most interesting discovery, it is suggested, is the radioprotective action of a simple substance, dimethyl sulfoxide (DMSO). DMSO also acts as a substitute for glycerol in preventing damage to both human and bovine red cells and spermatozoa, at low temperatures. Acute toxicity in mice is low. It was found that an intraperitoneal injection of ~ one-third the LD_{50} (4500 mg/kg body weight) administered to mice before an LD_{90} dose of whole-body x radiation (1007 rad) resulted in 70% survival. Several derivatives of DMSO and a number of other alkyl, alkyl-substituted, and aromatic sulfoxides were also examined. It was shown that this compound protects rats to a similar degree. X-irradiated mice were used to show: that anoxia is an effective protective agent; that there is some interrelation between the sulfhydryl group of chemical protectors and oxygen levels in the whole animal; and that there is a great necessity for research which distinguishes between additive and synergistic types of action of radioprotectant drugs. In vitro experiments on the influence of oxygen on the radiosensitivity of cells are critically examined and it is pointed out that O_2 tension is rarely controlled in studies assaying radioprotective agents in tissue cultures. Some hypotheses explaining the mechanism of action of O_2 and these agents are also considered. The effect of various protective and nonprotective compounds on the phosphorescent emission of riboflavin in frozen solutions in the presence or absence of oxygen were examined, and it was found that a remarkable correlation exists between the radioprotective action of sulfhydryl substances under conditions of anoxia and the ability of such compounds to render the triplet state of the flavin unstable in the absence of oxygen. (BBB)

29401 PROTECTION BY DIETARY FAT AFFORDED SERUM γ_1-GLOBULIN OF X-IRRADIATED RATS. Eloise Jameson, R. J. Martinez, and R. M. Ryan (Univ. of Southern California, Los Angeles). J. Nutr., 80: 370-4(Aug. 1963).

An investigation was conducted to determine whether protection from x rays by certain fatty acids could be correlated with any characteristics of blood serum proteins as determined by electrophoresis. Nine groups of rats were fed a 0% fat diet until body weights reached a plateau, after which the rats of three groups were given a supplement of methyl linoleate (100 mg/rat/day by stomach tube) for the duration of the experiment. Some received no supplement. Other groups of rats were fed a diet containing 15% cottonseed oil. Animals receiving all three diets were given 600 to 800 r x irradiation. Electrophoretic studies showed that x irradiation caused a substantial decrease in the concentration of γ_1-globulin in the serum of rats fed a fat-deficient diet. This change did not occur in rats that had been fed the fat-free diet plus a daily supplement of methyl linoleate or the diet containing 15% cottonseed oil. The similar body weights of the linoleate-supplemented rats and the fat-deficient rats demonstrated that the protective effect of dietary fat was not due simply to a mechanical shielding of the blood-forming organs by a fatty layer. It is suggested that the protection against x ray afforded by dietary linoleate or fat may be due to protection of the antibody-forming system, which is presumably responsible for synthesis of most of the serum γ_1-globulins. (BBB)

29402 A REVIEW OF THE ACUTE RADIATION SYNDROME IN DOMESTIC ANIMALS. PART II. CLINICAL SIGNS AND SYMPTOMS. J. H. Wilkens (Army Veterinary and Remount Services, Droitwich, Eng.). J. Roy. Army Vet. Corps., 34: 11-20(Spring 1963).

The acute radiation syndrome in Equidae, ruminants, goats, sheep, and dogs is described. Many experimental biologists believe that bacteremia and toxemia are major causes of the death of irradiated animals. It was found in unpublished studies that the clinical signs and post-mortem appearance of goats dying acutely from lethal doses of x irradiation are similar in some respects to Clostridium perfringens Type D intoxication found in pulpy kidney disease and enterotoxemia; hemorrhage also plays a major part in the radiation syndrome, the principal cause of hemorrhage being thrombocytopenia. The syndrome in the burro is described in detail. (BBB)

29403 MEDICAL SUPERVISION OF PERSONNEL EXPOSED TO IONIZING RADIATIONS. E. Bartalini and I. Ducci. Med. Lavoro, 54: 302-12(1963). (In Italian)

A brief account is given of the available methods of inspecting personnel exposed to ionizing radiations. Criteria are suggested for carrying out periodical preventive medical examinations, for measuring the dose received, and for registering data relative to each employee. The units most commonly used in the measurement of ionizing radiations, and the maximum permissible doses are stated. Methods recommended by the EURATOM commission for the determination of the total dose received are described. As regards the individual measurements of dose received, the combined use of an ionizing-chamber dosimeter and of a film-badge are recommended. The former allows immediate estimation of the degree of exposure, while the latter records data which may be useful also in the case of future disputes. It is recommended to use a separate file for each member of the staff exposed to the radiations. The need for close and systematic cooperation between the factory medical officer and the responsible technical supervisor whose duty is to note in a special register the total dose of radiations absorbed by each employee, are stressed. (auth)

29404 BURNS AND OTHER TRAUMA ASSOCIATED WITH RADIATION EXPOSURE. Edward H. Vogel, Jr. (Army Hospital, Okinawa). Military Med., 126: 688-92 (Sept. 1961).

Burn injuries associated with sublethal radiation injuries are discussed as exemplary of mechanical trauma and irradiation interactions. Bacteremia is identified as the most probable cause of death in such cases. The need for methods of treating burns acquired from nuclear explosions is pointed out, and the importance of treatment prior to the onset of radiation sickness is stressed. (H.M.G.)

29405 CLINICAL MANAGEMENT OF PATIENTS EXPOSED TO RADIATION DISASTER—AN OUTLINE. E. R. King (Naval Hospital, Bethesda, Md.). Military Med., 126: 693-7(Sept. 1961).

Current thinking of how to care for patients involved in peacetime radiation accidents is outlined. Application to wartime conditions is also possible. A table demonstrates the radioactivity present in a nominal size (500 Mw) power reactor after four months of operation with 12 hr of cooling following an excursion, or run-away. Another table outlines immediate procedures to be carried out once an accident is reported. At the National Naval Medical Center,

Bethesda, exposed patients would be evaluated as to their physical condition and external radioactive contamination according to a scheme shown in a third table and other tables outline the criteria used in deciding upon the management of these cases. An estimate of prognoses based upon radiation dosage is listed. Another table presents a description of the possible ways of exposure from which patients may suffer from various types of radiation accidents. The use of marrow grafts and antibiotics is discussed. (BBB)

29406 ANTI-RADIATION DRUG DEVELOPMENTS. David P. Jacobus and Michael P. Dacquisto (Walter Reed Army Inst. of Research, Washington, D. C.). Military Med., 126: 698-70(Sept. 1961).

The Army Medical Research and Development Command has initiated a drug development program, similar to that under which anti-malarials were developed, to find an anti-radiation agent useful for protecting man against radiation injury. The goal of this program is not to develop an agent more effective than those already available, but rather, the reduction of toxicity. The present compounds and the important lines of development are tabulated. The effectiveness of these chemicals against radiation injury in dogs exposed to 3 Mev x radiation is indicated. The protective mixture used to obtain most of the data shown was a combination of p-aminopropiophenone (5 mg/kg) and p-hydroxydiphenyl (10 mg/kg), intravenously one hr before radiation, followed by a mixture of mercaptoethylamine (100 mg/kg) and cysteine (300 mg/kg) just before exposure. (BBB)

29407 THE APPLICATION OF BONE MARROW TRANSPLANTS IN THE TREATMENT OF RADIATION INJURY IN MAN. M. Lenzi (Università, Modena, Italy). Minerva Med., 3: 91-4(Mar. 1961).

Various aspects of bone marrow replacement therapy following lethal irradiation doses are discussed and the author's experiments and clinical experiences are described. Processes of repair in the lymphatic tissue after transplantation of homologous spleen cells were studied by cinematography (phase contrast) in order to observe the behavior of the cells of lymph nodes of the lung in animals given conventional x-ray and ^{60}Co treatment. Damage to the circulating cells during the time of observation (from five to 20 hr after irradiation) was minimal even at doses of 7000 rad, so that the effect of total-body irradiation on the lymph cells seems mainly to involve their centers of production. The experience gained from the five Yugoslav workers involved in the accident with the reactor at Vinca is considered. Nearly all these patients have received less than a lethal radiation dose, and therefore homologous grafting did not take, or, when the dose was sufficiently high, it was yet incapable of preventing the recovery of the recipient's marrow and the consequent reappearance of the disease. By increasing the radiation dose to 850 rad with telecobalt it was possible to achieve good results in patients who, moreover, overcame the secondary disease and showed histopathological findings in the lymph glands that were very similar to experimental findings. Techniques for preservation of bone marrow are discussed, including a method that allows cells to be stored for more than three months at −73°C. The use of such preserved marrow in cancer patients treated with radiation, and additionally in some cases with antimitotic drugs, is described. Results with autologous stored marrow were successful in that none of the reactions occurring after homologous marrow transplantation were seen. (BBB)

29408 IRRADIATION DERMATITIS AND THE TRICHO INSTITUTE. George F. Crikelair, Robert W. Beasley, and Bard Cosman (Presbyterian Hospital, New York). N. Y. State J. Med., 64: 1193-7(May 15, 1964).

Fourteen patients with x-ray damage resulting from irradiation treatment for hypertrichosis in the early 1900's at the Tricho Institute are added to previously reported cases. The number of unreported or unsuspected cases must be much greater since it is difficult to elicit information from the patients who, many years after the event, feel guilt at having indulged in a seemingly simple cosmetic venture. Thirteen of the patients treated by the Tricho system were women. While some skin atrophy and telangiectasia generally developed in one to two years, maximum changes were usually encountered 10 to 30 years later. Eight of the 14 developed one or more malignant conditions. One patient who received Tricho treatment to the face, trunk, arms, and legs died 38 years later of acute myeloblastic leukemia. Two other patients who had received the most extensive radiation developed carcinomas of the breast. The history of the Tricho Institute and the career of its founder who administered this ill-advised therapy are reviewed. (BBB)

29409 HISTOPATHOLOGICAL STUDIES ON RADIATION PNEUMONITIS. I. STUDIES ON HUMAN AUTOPSY CASES. Tsuneo Namiki (Tohoku Univ., Sendai). Nippon Byorigakkai Kaishi, 51: 36-55(1962). (In Japanese)

Twenty-five autopsy cases of radiation pneumonitis were examined and classified histopathologically. No difference was noted between the reaction to x-ray and ^{60}Co irradiation. It is suggested that increase of capillary permeability of the alveolar wall is the primary pathogenic factor and that metabolic abnormalities of the alveolar epithelium and proliferated connective tissue are contributory factors. (BBB)

29410 HISTOPATHOLOGICAL STUDIES ON RADIATION PNEUMONITIS. II. EXPERIMENTAL STUDY. Tsuneo Namiki (Tohoku Univ., Sendai). Nippon Byorigakkai Kaishi, 51: 56-66(1962). (In Japanese)

Studies were conducted in x-irradiated rats and rabbits to elucidate the pathogenesis of the radiation-induced pulmonary changes observed in the patients undergoing radiotherapy described previously. When a total of 3000 r was given to one lung of rats, pathologic changes in the lungs were mild. Larger doses (6000–12,000 r) of radiation were given to four groups of rats. Most of the animals died shortly following irradiation, and bronchopneumonia was frequently present. It was felt that the pulmonary changes were modified by various factors which may not be directly related to irradiation. Pulmonary edema was found in most rats which received more than 9000 r. A third of these rats demonstrated the presence of hyaline membranes over the alveolar walls. In rabbits which received 3000 r the pulmonary changes were slight; the lungs showed only a slight degree of interstitial fibrosis and vascular changes. In rabbits which received a total of 10,000 r given in divided doses, there were marked pulmonary changes. The changes were similar to those seen in the intermediate stage of the mixed type observed in the human material. Though there was no significant difference between the pulmonary changes due to radiation in human beings and those seen in the experimental animals, exudative phenomena and other changes were mild in the latter. The difference is probably due to the differences in sensitivity of the alveolar capillary endothelium to radiation. In the experimental animals the pulmonary changes were classified as either interstitial-proliferative or mixed type, unless modified by complications. (BBB)

29411 THEORETICAL APPROACH TO LIFE-SPAN SHORTENING INDUCED BY RADIATION. 3. A MODEL FOR RADIATION INJURY. F. Sato, S. Tsuchihashi, K. Shibata, W. Nakamura, and H. Eto (National Inst. of Radiological Sciences, Chiba, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 322-7(June 25, 1963).

A model is proposed for radiation injury with consideration of both the injury of organs and interaction between organs. At present the experimental data applicable to this problem are few and it was not possible to compare quantitatively the model with data. Radiation injury of the whole body in mammals, such as life shortening, seems to involve the injuries of many organs and interactions between the organs. This model for radiation injury implies the following assumptions: each organ (or part of the body) shows a common measure of injury; it is possible to divide the injury of an organ into two components. One component is injury due to the direct effect of radiation delivered to the organ, called intrinsic injury. The other component is termed interaction injury which involves the interaction between various organs. By interaction between organs is meant the hormonal or nervous control of organs and transport of substances via the blood circulation or through cell membranes. According to these assumptions, an injury of the i-th organ, I_i, is divided into the two components as follows: $I_i = I_{ii} + I_{ai}$, where I_{ii} is the intrinsic injury of the i-th organ and I_{ai} is the interaction injury of the organ. In terms of n organs, I_i is defined as i-th component of n-dimensional injury vector I_0. If the i-th organ receives no radiation, I_{ii} vanishes but I_i is not necessarily zero owing to the second term of I_{ai}. The simplest type of the interaction between the organs is to assume that intrinsic injury, I_{jj}, of j-th organ directly affects the other organs but does not affect the third organ through the second organ. In this one-step interaction, by introducing the interaction coefficient A_{ij} from j-th organ to i-th organ, the total injury of of i-th organ I_i can be expressed as follows: $I_i = I_{ii} + \sum_{j=1} A_{ij} I_{jj}$. (BBB)

29412 CHANGES IN THRESHOLD AND PATTERN OF ELECTROSHOCK SEIZURES IN X-IRRADIATED RATS RECEIVING CHLORPROMAZINE AND RESERPINE. Fred Rosenthal and Paola S. Timiras (Univ. of California, Berkeley). Proc. Western Pharmacol. Soc., 4: 50-8(1961).

The effects of moderate doses of x irradiation on brain physiology and pharmacology are reported. Threshold and pattern of electroshock seizures and duration of post-ictal depression were measured in rats as an assessment of brain excitability, spread of excitation, and recovery processes. Brain excitability was measured by the electroshock seizure threshold (EST) test. After a 500-r exposure, the EST is significantly decreased and remained below control values for longer than 100 days. The central excitatory effect of irradiation was seen by a significant fall in the EST. Chlorpromazine and reserpine were administered to irradiated and unirradiated animals, and effects of the two agents on body weight were noted. Of the two drugs studied, reserpine markedly lowered the EST while chlorpromazine failed to decrease the threshold significantly. On the other hand, when chlorpromazine was administered to irradiated animals, the EST was significantly below control values. Furthermore the combination of irradiation and chlorpromazine resulted in a lower EST than either irradiation or chlorpromazine alone. The profound fall is EST produced by reserpine alone was not modified by irradiation. No observable changes in behavior were produced by irradiation alone, but chlorpromazine and reserpine produced behavioral sedation in control and irradiated rats. Both x rays and chlorpromazine shorten the total duration of the maximal electroshock seizure, a phenomenon mainly attributable to a decreased duration of clonus. Duration of post-ictal depression was prolonged after irradiation and more markedly prolonged after chlorpromazine. Administration of the drug potentiated the delay in recovery of the irradiated rats. The reduction in duration of total seizure and of tonic extension, as well as the delay in recovery, suggest that irradiation and chlorpromazine inhibited the spread of discharge and that this inhibition is greater after the combined treatment than after each individual agent. It is concluded that chlorpromazine and reserpine have either a synergistic or a potentiating effect on the changes occurring after irradiation, and that the two drugs and x rays act on similar metabolic substrates and at similar brain sites. (TCO)

29413 TRANSPLANTATION OF BONE MARROW: CURRENT PROBLEMS. Alberto P. Cristoffanini (Jefferson Medical Coll., Philadelphia). Progr. Hematol., 3: 360-76(1962).

This review, citing 122 references, outlines recent advances in the use of bone marrow grafting to prolong the survival of whole-body, lethally irradiated animals. Studies on chemical agents which afford protection against ionizing radiation are also reviewed, as are the procurement, processing, and administration of bone marrow. Clinical application of marrow grafting is discussed with particular reference to the treatment of the Yugoslav nuclear reactor workers, exposed to large γ-ray and neutron doses, who survived after bone marrow transplantation. (BBB)

29414 INFLUENCE OF H_2S ON THE RADIOSENSITIVITY OF ENZYMES AND MICROORGANISMS. Tor Brustad (Norsk Hydro's Inst. for Cancer Research, Montebello, Norway and Univ. of California, Berkeley). Radiation Res., 22: 421-30(July 1964).

A study was made of the radioprotection provided by H_2S bubbling of dilute solutions of lysozyme (0.1 mg/ml) in triple-distilled water, and suspensions of E. coli B, E. coli B/r, E. coli B-3, and S. sonnei in M/15 phosphate buffer. The relation between the radiosensitivity of lysozyme as a function of the concentration of dissolved H_2S was determined. Bubbling of the enzyme solution with 100% H_2S during exposure at room temperature reduces the radiosensitivity by a factor of about 180. The radiosensitivity of enzymes in frozen aqueous solution increased faster with increasing irradiation temperature than did that of dried enzymes. This shows that indirect effects contribute to the radiation damage of enzymes in frozen solution, the more so, the higher the sample temperature during irradiation. The radiosensitivity at room temperature of lysozyme exposed in the dry state was nearly equal to that in aqueous solution bubbled with 100% H_2S during the exposure. The effect of H_2S on the radiosensitivity of dried lysozyme was small. Thus, H_2S seemed to be very effective in suppressing indirect effects of radiation. For the four different types of bacteria studied, H_2S bubbling of the suspensions during the exposure provided a pronounced radioprotection, beyond that of oxygen removal by nitrogen bubbling. The relative radiosensitivities when bubbled with H_2S, N_2, and O_2 was 1.0, 1.4, and 3.9, respectively. (auth)

29415 RADIOMIMETICY AND RADIOSENSITIVITY. G. Poggi Longostrevi (Ospedale di Circolo, Desio, Italy). Radiobiol. Latina, 6: 127-46(Apr.-June 1963). (In Italian)

The principal effects of the ionizing radiations on cells were reviewed. It was recalled that only alkalizing agents may be considered radiomimetic poisons, since other substances (like ethylene glycol, urethane, antifolics, corti-

sone, formal and azo dyes) show only some of the actions characteristic of ionizing radiations. The mechanism of action of alkalizing agents is described and attention is given to the differences between the effects of these drugs and those of ionizing radiations. Substances showing a radiosensitizing activity such as oxidants, photosensitizants, thiols, chinones, substances of the Actinomycin D type, iodoacetate, and cycloesanol succinate are reviewed. The mechanism of action and possible therapeutic use in oncology of each are described. (auth)

29416 COMPARISON OF THE EFFECTS OF SULFHYDRYL DERIVATIVES IN PROTECTION AGAINST X RAYS AND AGAINST RADIOMIMETIC POISONS. F. Bonati, G. Savino, and M. L. Tognacca (Ospedale Maggiore, Novara, Italy and Laboratori di Ricerche Bracco Ind. Chim., Milan). Radiobiol. Latina, 6: 167-80(Apr. June 1963). (In Italian)

The protective action of a group of sulfhydryl compounds against x rays and radiomimetic poisons (Chlormetine) was compared. Some parallelism between both actions was observed, however it was not absolute. Compounds having a low toxicity and possessing a sulfhydryl group, an amino-group, and an acidic radical such as cysteamine monoacetic acid and N_2-thioethyltaurine, appeared to be very efficient as antagonists of radiomimetic poisons. On the other hand, mercaptoethylguanidine did not prove to be as active as it was as a radioprotective agent. (auth)

29417 THE IMPORTANCE OF CELLULAR COMPOSITION OF BONE-MARROW SUSPENSION FOR THEIR THERAPEUTICAL EFFECT. D. G. Zographov (Radiobiologische Forschungsinstitut, Sofia). Radiobiol. Radiotherap., 5: 333-8(1964). (In German)

In an experiment with irradiated rats the intraperitoneal application of bone-marrow taken from phenylhydrazine pretreated donors was found to be less effective than bone marrow of normal donors. This fact was related to the number of cells injected of individual cell series and to the number of cells with the greatest proliferative activity, respectively. The results are considered an indirect proof of the humeral efficiency of intraperitoneally applied bone marrow. It was concluded that the maximum therapeutic effect depends on the introduction of different cell types in an optimum proportion as is found in normal bone marrow. (auth)

29418 THE EFFECTIVENESS OF BONE-MARROW TRANSPLANTATION. D. G. Zographov and I. A. Baev (Radiobiologische Forschungsinstitut, Sofia). Radiobiol. Radiotherap., 5: 339-45(1964). (In German)

In experiments with irradiated rats, homologous bone-marrow transplantation from polycythemic donors was found to be less effective than bone-marrow from normal donors. The number of injected cells and their proliferative activity were determined. A reduced effectiveness was noted in bone marrow which contained a high number of erythroblasts. It was concluded that for the maximum influence of the final picture of acute radiation injury the substitution of all cell series in such a proportion as is found in normal bone-marrow was important. (auth)

29419 THIETHYLPERAZINE IN THERAPEUTIC RADIATION SYNDROME. M. Svoboda (Institut fur Hamatologie und Bluttransfusion, Prague). Radiobiol. Radiotherap., 5: 347-51(1964). (In German)

Favorable results are reported for the use of thiethylperazine as suppositories and sugarcoated pills for the suppression of acute symptoms of radiation sickness. Results are reported for 30 sick persons treated with x rays for different hemoblastoses and malignant lymphomas. (auth)

29420 A METHOD FOR ESTIMATING THE PROPHYLAXIS OF RADIATION INJURY BY MEANS OF L-CYSTEINE. M. Timar, E. Repciuc, and C. Draghici (Chemisch-Pharmazeutischen Forschungs-Institut, Bucharest). Radiobiol. Radiotherap., 5: 379-83(1964). (In German)

A disturbance of metabolic conditions in the reticuloendothelial system (RES) was found to be caused by irradiation. The radioprotective effect of l-cysteine was tested by measuring the sleeping time of mice after the administration of evipan. With this method a protective effect of cysteine was not determined. It was concluded the cysteine caused loading of the RES and that in the future only those radioprotective substances which do not burden the RES should be used. (auth)

29421 CELL-SURVIVAL DATA AND THE IRRADIATION RESPONSE OF SOME NORMAL TISSUES. C. W. Wilson (Westminster Hospital, London). Radiology, 83: 120-30(July 1964).

An attempt is made to interpret the response to irradiation of the intestine of the rat and mouse solely in terms of cell survival data and other experimentally established facts of radiation response, such as division delay and postirradiation cell division. One objective of this attempt was to emphasize that it is unnecessary to invoke other, more nebulous concepts that have not been experimentally established. It is shown that satisfactory interpretation was possible for acute radiation doses within the limitations set by lack of detailed knowledge of the cellular response that actually occurs and of the actual parameters relevant to the tissue in question. It is more difficult to explain the response observed to continuous irradiation at low-dose rates, but an attempt has been made by invoking cellular recovery ideas and cell division delay effects. The study leads to the conclusion that the cellular response of the intestine should be examined for certain acute and chronic dose levels if the applicability of the theoretical concepts are to be tested with the maximum efficiency. So far, this response has not been examined in detail. (auth)

29422 THE FUNCTION OF THE SPLEEN IN THE REACTION OF BONE MARROW TO WHOLE-BODY IRRADIATION. J. G. Gostomzyk, R. Arnold, and G. Ruhenstroth-Bauer (Max-Planck-Institut fur Biochemie, Munich). Schweiz. Med. Wochschr., 93: 1490-2(1963).

In-vitro experiments on ^{32}P incorporation and cell-electrophoretic mobility following total-body irradiation in rats indicate that the spleen regulates the metabolism of the bone marrow and the release of granulocytes from the bone marrow. (Excerpta Med., Sect. XXIII, 1: No. 3, (March 1964)).

29423 INVESTIGATIONS ON BIOLOGICAL RADIATION PROTECTION. PART 52. THE INFLUENCE OF RADIOPROTECTIVE MATERIALS ON THE RADIOIRON EXCHANGE AFTER WHOLE-BODY IRRADIATION UNDER 100 r. Ruprecht Koch and Irma Seiter (Universität, Freiburg i. B.). Strahlentherapie, 124: 99-107(May 1964). (In German)

When 0.2 μC of ^{59}Fe was injected intraperitoneally into white mice 24 hours after whole-body irradiation with 25, 30, 40, 50, and 75 r, the influence of irradiation upon the incorporation of iron into the young erythrocyte populations was followed up to 7 days. A significant decrease of radioiron incorporation, compared to non-irradiated controls,

occurred for doses up to 30 r. Animals, which were kept for 8 weeks in a climate closet corresponding to a height of 5100 m above sea level, and brought to normal atmospheric conditions prior to the radioiron test showed only during the first 2 days the same iron incorporation observed in the controls. Later on, the incorporation was significantly decreased suggesting, possibly, that erythropoiesis, after returning to normal atmospheric conditions, was decreased. The radioinduced inhibition of the radioiron incorporation into the erythrocytes was diminished, if the mice received cysteamine, serotonine, or histamine as radiation protective substances before a whole-body irradiation with 75 r. The same effect was observed when a splenectomy was done 1 hour after irradiation. A dose reduction factor of 2.5 was found for cysteamine and histamine and of 1.5 for serotonine or splenectomy. The protection appears at once and not later on as a better regeneration. (auth)

29424 INVESTIGATIONS ON THE DISTRIBUTION AND ACTIVITY OF SOME ENZYMES OF THE THIN INTESTINAL MUCOUS MEMBRANE IN VARIOUS STATES OF ACUTE RADIATION SICKNESS. Stanislaw Kosmider, Jan Jonek, and Józef Kaiser (Schlesische Medizinischen Akademie, Zabrze, Poland). Strahlentherapie, 124: 261-9 (June 1964). (In German)

The distribution and activity of the alkaline phosphatase, ATP-ase, succinic acid dehydrogenase, and DPNH-diaphorase in the mucous membrane of the jejunum were determined histochemically for certain stages of acute radiation sickness. The observed decrease in enzyme activity was correlated to the reduction of the active transport in the intestinal wall. The disturbances in absorption might be caused by these enzymatic changes. Activity increase and diffuse undifferentiated enzyme distribution were observed in the pre-agony stage. The authors explain this with degeneration events in the intestinal wall. (auth)

29425 INVESTIGATIONS ON THE MECHANISM OF THE RADIOPROTECTIVE EFFECT OF CYSTEAMINE. Erwin Magdon (Robert-Rossle-Klinik der Deutschen Akademie der Wissenschaften, Berlin). Strahlentherapie, 124: 284-7(June 1964). (In German)

The radiation protective effect of cysteamine (mercaptoethylamine MEA) was investigated in total-body irradiated A/Jax-mice using hypothermic conditions, and in Ehrlich-carcinoma-ascites-cells using different O_2-tensions. The experiments showed that the radiation protective effect of cysteamine is eliminated under the hypoxia of mice which is caused by hypothermia and at the decreased O_2-concentration of the ascites-cell suspension. It is concluded, that the effect of cysteamine is based on competitive reactions between cysteamine and O_2 with the radiation induced radicals in biologically important molecules and thus upon the inhibition of the oxidation or peroxidation of the molecules. (auth)

29426 INVESTIGATIONS ON BIOLOGICAL RADIATION PROTECTION. PART 53. THE EFFECTIVENESS OF HISTAMINE ON RADIOINDUCED CHANGES IN AMINO ACID METABOLISM. Hans-Joachim Melching, Christian Streffer, and Utz Allert (Universität, Freiburg i. B.). Strahlentherapie, 124: 288-301(June 1964). (In German)

Administration of histamine dihydrochloride prior to sublethal total-body irradiation influenced radiation-induced changes in the amino acid metabolism in mice. The effectiveness of this substance in regard to excretion of kynurenin, kynurenic acid, and anthranilic acid was different from that obtained with other substances, such as serotonine, pyridoxal-5-phosphate + AMP, or splenectomy. In regard to radiation-induced changes in excretion of xanthuric acid and taurine, about the same results were obtained for all prophylactically effective substances as well as with prophylactic splenectomy. (auth)

29427 IS THE IRRADIATION MENOPAUSE SAFE? A PRELIMINARY REPORT. Evan V. Shute (Shute Inst., London, Ontario). Sum. Shute Inst. Clin. Lab. Med., 14: 31-6(Dec. 1962).

The relative advantages and hazards of radiation and surgery in the treatment of menopausal bleeding are compared. The literature relating to the pros and cons of radiation and surgical induction of the menopause are reviewed and a survey is made of 225 patients who received radiotherapy for menorrhagia. The x-ray-induced menopause takes a month to develop, is similar symptomatically to spontaneous menopause, and rarely induces troublesome side-effects. Although an average of 10 years' follow-up studies in these patients showed development of cancer in 8 cases, there was no convincing evidence that irradiation precipitates more uterine cancer than would normally have developed in 225 women over an average period of 10 years (two among 225 cases). Fifteen patients later required surgical hysterectomy for various reasons. Endometrial hyperplasia was found in 49 of the 213 patients on whom records of curettage were available. In two cases, acute cellulitis developed after irradiation during existing pelvic inflammation. It is concluded that this mode of handling menopausal bleeding is safe, can be applied even in the presence of myomas of large size, does not predispose to the appearance of cancer later, but should not be given if there is concomitant pelvic inflammation. Endometrial hyperplasia does not seem an especially ominous finding. Its rival method, hysterectomy, carries a morbidity and mortality that generally costs the patient much more, demands more hospital care, and leaves the women relatively incapacitated for an appreciable period. These results indicate that the irradiation menopause is safer, cheaper, easier, less debilitating, and all these women lived. The menopausal symptoms of the irradiation menopause are strictly comparable to those developing at the natural menopause. (BBB)

29428 PHOTO-PROTECTION AND HUMAN MALIGNANT CELLS. P. O'B. Montgomery, John Prince, James Cook, and R. C. Reynolds (Univ. of Texas, Galveston). Texas Rept. Biol. Med., 22: 152-5(Spring 1964).

Ultraviolet light is generally considered to be the carcinogenic wavelength involved in the solar production of human and mammalian skin cancer. The question of whether or not photoprotection is a property of human malignant cells, and the lack of data on photoprotection effects in human malignant cells, prompted experiments in HeLa cell cultures. HeLa cells were exposed to uv light alone and to a combination of uv light and each of two wavelengths of visible light. The survival times of these two groups of cells were measured, and found to be virtually identical. Photoprotection under these conditions does not appear to be a property of the HeLa strain of human malignant cells. Previous photoprotection experiments involving the production of skin carcinomas in Swiss mice were reported, but they failed to demonstrate a significant difference between the rates and numbers of squamous cell carcinomas induced in the skins of Swiss mice when they were irradiated with a combination of uv and visible light, as compared with irradiation by uv light alone. The experi-

ments recorded here are similar, with the exception that they were performed at cellular level utilizing cells that were already malignant. Other work has demonstrated that uv-induced damage to hamster chromosomes may be photo-reactivated by post uv irradiation with light of 3300 Å, and uv-induced damage in bacterial DNA may be accounted for by the production of thymine dimers. Visible light restores biological activity to this DNA by breaking these thymine dimers. The possibility that the failure of photoprotection to occur in these malignant cells may mean that their DNA has been altered by the malignant change. (BBB)

29429 STUDIES ON THE FERTILITY OF THE JOACHIMSTAL MINERS. C. Mueller, M. Kubat, and J. Marsalek (Betriebsgesundheitsanstalt der VEB Joachimstaler Bergwerke, Czechoslovakia). Zentr. Gynaekol., 84: 63-8(Jan. 13, 1962). (In German)

To evaluate the possible effects of prolonged low-dosage irradiation on human fertility, statistical studies were made of 1000 miners employed in the Joachimstal mines which are rich in U and Ra and their daughter products. The subjects studied had worked in the mines from one to 31 yr, with an average of 6.5 yr. The radiation dose, determined by personal film dosimetry, ranged from 0.01 to 0.38 rem/week; the Rn concentration in the atmosphere of the mine varied from 1×10^{-11} to 1×10^{-9} C/l. A total of 1908 children were born to these 1000 miners. An analysis of the data, according to age of the subjects and the number of children born before and after exposure began, was made. In the age group of 25 yr or younger the number of children increased after as compared with before exposure, as expected. In the 25 to 30 age group the number of children was about the same before and after exposure, and in the 31 to 35 age group the number declined after exposure, as expected on account of naturally lower fertility with advancing age. It was concluded, considering the whole sample, that there was no detectable impairment in fertility in these miners which could be attributed to occupational radiation exposure. (BBB)

29430 ON THE PROBLEM OF THE GENETIC EFFECT OF IONIZING RADIATION ON JOACHIMSTAL MINERS. C. Mueller, V. Rericha, and M. Kubat (Joachimstal Mining Co., VEB, Czechoslovakia). Zentr. Gynaekol., 84: 558-60 (Apr. 14, 1962). (In German)

In a previous study it was reported that up to the time of their hospitalization 1000 Joachimstal miners had 1908 children, with a boy/girl ratio of 98.7/100. This ratio disagrees with the normally accepted value. Prior to the time of their period of exposure to radiation the miners studied had 1192 children, with a boy/girl ratio of 107.6/100. After exposure of the fathers the ratio for 716 children was 85.4/100. For fathers up to age 45, the number of boys born before radiation exposure was greater than the number after exposure. (BBB)

Radiation Hazards and Protection

29431 REPORT ON DEVELOPMENTS IN THE DOSIMETRY OF FAST ELECTRONS. PART 3. PRACTICAL DOSIMETRY. Benno Markus (Universität, Göttingen, Ger.). Strahlentherapie, 124: 33-53(May 1964). (In German)

The theoretical and experimental basis and methods for the dosimetry of fast electrons are discussed. A survey on results in dosimetry used for fast electrons is given. The energy dose as function of the ionization dose was calculated for an energy interval from 1 to 50 Mev; Bragg-Gray conditions were considered for two boundary cases: the "exact" and the "conditioned" electron equilibrium. The results agreed well with comparable measurements. The question concerning the influence of a focused electron beam as well as the total energy spectrum varying with body depth is discussed. The value for the average energy loss per ion pair to be used is discussed. (auth)

29432 MEASURING OF DOSES RECEIVED BY THE PERSONNEL IN RADIOLOGICAL DEPARTMENTS AND ITS IMPORTANCE. Adolf F. Lindblom (Central Hospital, Växjö, Sweden). Strahlentherapie, 124: 69-74(May 1964).

Experiences in monitoring of personnel in x-ray diagnosis, in radiation therapy, and in isotope work are reported. The difficulties in hiring technical personnel for the handling of radiation are discussed. (auth)

29433 IL RISCHIO DA RADIAZIONI NELL'ERA NUCLEARE. (The Risk of Radiations in the Nuclear Age). E. Jacchia. Milan, Ed. A. Giuffre, 1963. 607p. 4600L.

The hazards of ionizing radiations to humans and possible radioprotective countermeasures are discussed, with emphasis on the known biological effects of radiation, recommendations of international bodies relating to acceptable levels, legislation for regulation of medical and occupational exposure, and the transport and handling of radioisotopes. (BBB)

Radiotherapy and Radiodiagnosis

29434 (BNL-8032) BIOMEDICAL REACTOR INVESTIGATIONS. V. P. Bond (Brookhaven National Lab., Upton, N. Y.). May 6, 1964. Contract AT-30-2-GEN-16. 36p. (CONF-559-1)

From Symposium on the Utilization of Research Reactors, Atlanta, Nov. 1963.

Radiobiological investigations using reactor beams and approaches to the therapy of neoplasms using neutrons are discussed. Means of concentrating flux in tumors and cancers are discussed. (R.E.U.)

29435 (COO-119-229(p.74-9)) CONSIDERATIONS IN RADIUM THERAPY FOR MELANOMA. Charles W. Mays, Glenn N. Taylor, David R. Atherton, Ray D. Lloyd, Daniel Oniki, and Webster S. S. Jee (Utah. Univ., Salt Lake City. Coll. of Medicine).

Data are reviewed on the treatment of human melanoma with injected ^{226}Ra. Preliminary data are presented for one human case with poor results, one dog with excellent results, C57 mice, and golden hamsters. It is suggested that the uptake of a tracer injection of ^{226}Ra by the melanoma should be established before human patients are subjected to treatment. (C.H.)

29436 (COO-119-229(p.152-69)) Sr^{89} THERAPY OF A CANINE OSTEOSARCOMA. R. D. Lloyd, C. W. Mays, G. N. Taylor, D. R. Atherton, Jean H. Dougherty, and D. H. Taysum (Utah. Univ., Salt Lake City. Coll. of Medicine).

Strontium-89 was used in the attempted treatment of a moderately calcified osteosarcoma in a beagle. Pretreatment volume doubling time of the tumor was about 20 days. Six weekly injections were given the animal totaling 8.7 mC ^{89}Sr. The growth of the tumor appeared to have been arrested temporarily beginning two weeks after the first injection until about six weeks after the final injection. Thereafter, the tumor enlarged with a volume doubling time of about 50 days for the remaining five weeks

of the animal's life. A ^{89}Sr assay of selected tissues at death showed that the concentration was proportional to both the degree of calcification and to the rate of growth. The average radiation dose to the tumor was about 10,500 rads at death, whereas that to the skeleton was 1,000 rads. Regrowth of the tumor appeared to be most rapid in the lightly mineralized periphery where the ^{89}Sr content and local dose were lower. (auth)

29437 (AEC-tr-6428) USE OF I-132 FOR DIAGNOSTIC STUDIES OF THE THYROID GLAND. Mozart F. Azevedo and Walter L. Trancoso (Brazil. Comissão Nacional de Energia Nuclear). [nd]. (A translation)

A simple ^{132}I generator, consisting of a ^{132}Te source prepared by Brookhaven National Laboratory, is described that makes possible the use of this short-lived isotope distant from the place of production. The ^{132}I generator provides a rather inexpensive source of this isotope in a form that can easily be used by private physicians and that does not require involved equipment. It is pointed out that the use of ^{132}I permits a sizeable reduction of the radiation dose to the thyroid gland when compared with the radiation dose from ^{131}I and that ^{132}I can be used in clinical diagnosis. A clear distinction between hyper- and hypo- or euthyroidism was observed 100 min. after administration of a diagnostic dose of ^{132}I. Two-hour uptake studies of ^{132}I using the neck/thigh ratio proved convenient tests for a quick diagnosis of hyper- and hypo- or euthyroidism. Suppression tests using triiodothyronine or thiocyanate and stimulation tests with ISH or pituitary gland extracts presented comparable results with those obtained with ^{131}I. Tests using ^{132}I can be repeated frequently, and ^{132}I should be used for all studies of thyroid function in children and pregnant women because of the reduced radiation dose to the thyroid gland. (C.H.)

29438 THE CARDIAC IMPULSE FREQUENCY MEASUREMENT OF I^{131}-HIPPURAN; A NEW METHOD FOR INVESTIGATING THE FLOW OF VENTRICULOATRIAL SHUNTS AND AS A TEST FOR VENTRICULAR RESORPTION AND FOR THE DIFFERENTIAL DIAGNOSIS OF HYDROCEPHALUS. F. Mundinger, M. Anlauf, and G. Bouchard (Universität, Freiburg i.B.). Acta Neurochir., 11: 272-86(1963).

An account is given of two radioactive tracer methods with ^{131}I-Hippuran as a means of investigating flow and resorption in hydrocephalus. The authors investigated the flow through ventriculo-atrial shunts by making an intraventricular injection of 10 to 20 μC of ^{131}I-Hippuran, and by means of the one-way valve of Pudenz-Heyer or of Spitz-Holter the fluid was transmitted to the heart and from thence the gamma activity of the ^{131}I-Hippuran leaving the heart could be recorded as an individual impulse. By means of this direct method of measurement leading to a transient raising of the impulse frequency, the flow capacity of the by-pass system is either immediately recognizable on the register marker or may be demonstrated by statistical analysis. By analyzing the rate of decay (expressed as effective half-life) of the ventricular ^{131}I-Hippuran depots the authors could diagnose the different forms of hydrocephalus by the flow through shunts. Statistically verified differences in the effective half-life time allowed one to differentiate between obstructive and communicating hydrocephalus. The technique of measurement as well as the clinical experiences in 17 patients are fully described. Computations of the dose show that if 10 μC were used as a basis, the effective tissue concentrations obtained were 38% of a protracted ^{131}I-Hippuran release in the most unfavorable cases, and usually it was 6 to 20%. Thus, the effective total accumulated dose amounted at most to only 0.044 rad, so that the ^{131}I-Hippuran technique for measuring c.s.f. flow and resorption is, from the point of view of radiation hazards, quite clearly free from risk and completely reliable. (Excerpta Med., Sect. XXIII, 1: No. 1, (Jan. 1964)).

29439 COMPLETE ORAL RECONSTRUCTION IN CONJUNCTION WITH COBALT 60 TELETHERAPY FOR CARCINOMA OF THE TONGUE. A CASE REPORT. S. Gains Stubbins. Am. J. Roentgenol., Radium Therapy Nucl. Med., 92: 59-63(July 1964).

A 56 year old white woman developed xerostoma, stomatitis and rampant dental caries as an indirect result of cobalt-60 teletherapy for cancer of the tongue. Two years and ten months after irradiation and after a favorable biopsy report, complete coverage of all teeth with veneered gold crowns and replacement of missing teeth with fixed bridges were considered justified as the only means by which the decay process could be stopped and her teeth preserved. This was accomplished in 3 basic steps over a period of 4 weeks. At this writing, 6 months later, the patient is free of stomatitis and the xerostoma is improving. Her appearance and morale are much improved. Mastication is comfortable and her oral hygiene can now be maintained at a high level. This simplified technique for oral reconstruction causes a minimum amount of discomfort and inconvenience to the patient over a much shorter period of time. Experience has shown that teeth which are completely covered with well fitting gold veneer crowns will not decay following irradiation in the region of the salivary glands. Crowning of all the teeth prior to radiation therapy is therefore recommended as a prophylactic measure instead of total extraction of the teeth before irradiation. This case demonstrated the effectiveness of the same technique in preserving the teeth after irradiation. (auth)

29440 THE SENSITIVITY OF THE POSITRON SCINTILLATION CAMERA FOR DETECTING SIMULATED BRAIN TUMORS WITH GALLIUM 68-EDTA. Alexander Gottschalk and Hal O. Anger (Univ. of California, Berkeley). Am. J. Roentgenol., Radium Therapy Nucl. Med., 92: 174-6(July 1964).

Phantom studies indicate that the positron scintillation camera is a more sensitive instrument for the detection of brain lesions after the administration of ^{68}Ga-EDTA than the conventional positron scanner. It detects lesions $\frac{1}{3}$ to $\frac{1}{5}$ as large in volume for each ratio of tumor to head concentration studied. (auth)

29441 THE SIGNIFICANCE OF PHOTOMULTIPLIER FATIGUE IN SOME MEDICAL ISOTOPE TECHNIQUES. Booker T. Moore (Veterans Administration Hospital, Albany, N. Y.). Am. J. Roentgenol., Radium Therapy Nucl. Med., 92: 187-91(July 1964).

Photomultiplier tube fatigue can develop in the equipment and procedures used in routine medical radioisotope work. It can cause a falsely increased or decreased count rate. An affected tube will function abnormally during counting subsequent to the development of fatigue and until recovery has taken place, which may require several hours. (auth)

29442 THE TREATMENT OF RADIONECROSIS WITH PERSISTENT CANCER OF THE HEAD AND NECK. Claude C. Coleman, Jr. and John E. Hoopes (Univ. of Virginia, Charlottesville). Am. J. Surg., 106: 716-20(Nov. 1963).

Problems in radiotherapy are exemplified by a survey of 30 patients with persistent cancer following intensive radia-

tion therapy. Complications of irradiation included radionecrosis of the soft tissues, observed within two to three months after completion of therapy, and as late as 35 years afterwards. In ~35% of patients receiving radiation therapy for intraoral neoplasms, soft tissue necrosis developed. Resection of the involved devitalized bone often afforded immediate relief of pain. The gravest problem was coverage of the carotid artery, since most of these patients required resection of large amounts of radionecrotic skin and muscle. The use of adjacent pedicle flaps, muscle flaps, and skin grafts was not consistently effective, and nine patients sustained permanent, irreparable injury to the carotid artery. In at least one case radiation appeared to induce a secondary cancer. It is concluded that radiotherapy usually is not effective in eradicating cancers of the head and neck and greatly impairs further treatment by surgery. (BBB)

29443 TREATMENT OF HYPERTHYROIDISM WITH ^{131}I. George Crile, Jr. (Cleveland Clinic Foundation). Am. J. Surg., 107: 545-6(Apr. 1964).

The effectiveness and possible hazards of ^{131}I used in therapy of Graves' disease are discussed with reference to its application in >2000 patients. The clinical results indicate that it is the simplest, most effective, and most economical therapy for Graves' disease. The effects ^{131}I may have on reproductive function, and genetic effects it may have in the children of women treated with it, are discussed. Whether it has an effect on bone marrow, and how often leukemia is induced by the administration of ^{131}I are also considered. It is concluded that the issue is not whether or not radioiodine induces cancer, but how often it is likely to induce cancer, how often the cancer that ensues is likely to be fatal, and how the risk of occurrence of fatal cancer compares with that involved in thyroidectomy. (BBB)

29444 THE USE OF A DIGITAL COMPUTER IN EVALUATING RADIATION EXPOSURE DURING FLUOROSCOPIC EXAMINATIONS. Perry Sprawls, Jr., W. B. Miller, Jr., and J. H. Cosper (Emory Univ., Atlanta). Ann. Conf. Eng. Med. Biol., 16th, Baltimore, 1963, 124-5(1963).

A special punch-tape recorder and a Univac Solid-State-90 digital computer were used to determine patient exposure and to study the various exposure parameters. This method enables study of the changing conditions throughout an x-ray examination. Exposure parameters were used to compare exposures during various examination conditions. (BBB)

29445 INTRAUTERINE IRRADIATION AND IRIS HETEROCHROMIA. E. A. Cheeseman (Queen's Univ., Belfast) and A. L. Walby. Ann. Human Genet., 27: 23-9 (Aug. 1963).

Preliminary results of earlier studies suggested that x irradiation of the fetus in utero increases the risk of leukemia and the frequency of heterochromia of the iris and possibly other localized pigmentary mosaics. Data on heterochromia of the iris was collected at routine school medical inspections to test the implied hypothesis. This report describes the procedure adopted and the results obtained at the inspection of all new entrants, aged 4 to 7 years, in Belfast schools during the calendar year 1961. (BBB)

29446 ACUTE LEUKEMIA AFTER RADIOTHERAPY FOR MALIGNANT TUMORS (CONSIDERATION OF TWO CASES). P. Michon, A. Larcan, F. Streiff, A. Peters, and Ph. Canton. Ann. Med. Nancy, 2: 136-42(Jan. 1963). (In French)

X-ray induction of leukemia apparently is dependent on individual susceptibility which varies with genetic make up, age, and hormonal status of the irradiated subject. Two age groups exist in which radiation-induced leukemia susceptibility is at its highest: infants and adults over 45 years of age. These are also the age groups of increased leukemia incidence. The mechanism of x-ray leukemogenesis was not established, and whether a radiation dose threshold exists for leukemia is not known nor whether the ratio of dose to frequency is linear. The two cases observed in this study of post-radiotherapy leukemia occurred in subjects irradiated for malignant tumors. One of the patients was irradiated (40 sessions, total dose unknown) following radical unilateral mastectomy, and the other after excision of a tumor-bearing testicle (irradiated with an unknown dose over 150 sessions). Both patients presented acute leukemia. Both were adults over 45 showing apparent recovery from the primary neoplasms, from which there were no metastases. The clinical picture included acute severe anemia with a slight hemorrhagic syndrome at first and accentuated terminally. In one case the acute leukemia was of the myeloid type, in the 2nd it was acute lymphoid leukemia. In both cases the platelet count was very low, and the fatal outcome was rapid. It is suggested that the problem in the radio-leukemia field is not whether ionizing radiation can cause leukemia but consists in determining the amount of radiation required and ways of preventing its development. (BBB)

29447 MICROPATHOLOGY OF RADIATION REACTION IN THE LARYNX. Fred W. Alexander. Ann. Otol. Rhinol. Laryngol, 72: 831-41(Sept. 1963).

The microscopic pathology resulting from irradiation of the normal structures of the larynx is described. The normal tissues of the larynx resist γ-radiation doses of less than 2500 r and will tolerate 5000 r in the usual divided therapeutic dosage (5000 r is needed for the eradication of most squamous cell carcinomas of the larynx). There is variation of the amount of damage to normal tissues among individuals, as well as tumors, a phenomenon yet unexplained. The histologic sections described were obtained from 12 cases irradiated with ^{60}Co or 250-kv or supervoltage units (7000 to 7500 r) in an average of 40 doses covering a period of 50 days. The most significant damage was that produced in blood vessels and lymphatics. Direct and indirect radioinduced modifications of the blood vessels and lymphatics are discussed in detail. Other injuries noted include those of: epithelial tissue, cartilage, and bone. (BBB)

29448 OCCURRENCE OF A MALPIGHIAN EPITHELIOMA ON A PREVIOUSLY IRRADIATED LYMPHOSARCOMA OF THE NASAL CAVITY. F. Pain, E. Martin, and Cl. Mathieu. Ann. Otolaryngol. (Paris), 80: 717-19 (July-Aug. 1963). (In French)

Observations were made on a case of malpighian epithelioma which developed 14 years after Ra therapy for an isolated, nonmetastatic lymphosarcoma of the nasopharynx. This therapy consisted in implantation of 30 mg of Ra for five days in the nasal cavity. Serious radionecrotic lesions developed five months later, consisting of an extensive mutilating infected ulceration of the palate, which became perforated in spite of penicillin treatment. Surgical correction of the defect and insertion of a prosthesis were performed once the infection could be controlled. This patient was seen again 14 years later at which time a spinocellular epithelioma had developed on the left lateral wall of the nasal cavity, presenting as a transformation with the neighboring metaplasic mucosa. No lympho-

sarcomatous proliferation representing the original neoplasia was now evident. Electrocoagulative surgery was applied and the patient watched closely. No further radiation was administered for fear of reinitiating necrosis. The occurrence of this tumor was compared with degenerative and neoplastic changes observed around lesions in skin or mucosa from thermal or chemical burns. (BBB)

29449 RETICULOSARCOMA OF THE FRONTAL SINUS AND UNUSUAL COMPLICATIONS OF ITS RADIATION AND SURGICAL TREATMENT. A. R. Antonnelli and F. Piotte (Università, Sassari, Italy). Arch. Ital. Otol. Rinol Laringol., 74: 287-96(Mar.-Apr. 1963). (In Italian)

The development of cerebral radionecrosis and other complications of radiotherapy are described. The patient was originally treated for an invasive, undifferentiated reticulosarcoma of the left frontal sinus. Before surgical removal of the tumor, the tumor-bearing region was x irradiated with a total skin dose of 7400 r, administered in 24 fractions. Radiodermatitis developed immediately, and cerebral radionecrosis was demonstrated histologically three years later. The skin-grafting techniques are described, and the cosmetic improvement in the radiation-injured area is illustrated at the various stages of surgical treatment. (BBB)

29450 CONDITIONS OF APPEARANCE AND PREVENTION OF POST-RADIOTHERAPEUTIC RECTITIS IN TREATMENT FOR CERVICAL CANCER. G. L. Dulac and J. Rousseau. Arch. Maladies App. Digest. Maladies Nutr., 52: 5-20(1963).

Complications associated with the treatment of cervical cancer with Ra are discussed. Emphasis is placed on the prevention of post-radiotherapeutic rectitis. It is pointed out that serious mishaps may occur in a pathological area which has already previously affected the pelvic tissue. Most of the serious mishaps occur when the tumoral ramifications are extensive, and it is sometimes difficult to decide to what extent the deterioration in the general condition of the patient is due to relapse or complication. These mishaps are rare and represent only about 2.5% of the cases treated. The risk is not very great in comparison with the results obtained by radiotherapy. Prevention by drugs has not given very definite results. On the other hand, it is essential to prevent the administration of an excessive radiation dose, and an attempt should be made to ensure this by publication of recommended techniques; use of apparatus which makes the application of radium safer; research into better dosimetry; research into better distribution of the dose; and perfection of combined radium and cobalt therapy. (Excerpta Med., Sect. XXIII, 1: No. 2, (Feb. 1964)).

29451 SYMPTOMS, DEVELOPMENT AND MEDICAL TREATMENT OF POST-RADIUM THERAPY AND RADIOTHERAPY ANOPROCTITIS (AND PROCTOSIGMOIDITIS) DURING TREATMENT FOR CANCER OF THE CERVIX OF THE UTERUS. P. Dissard. Arch. Maladies App. Digest. Maladies Nutr., 52: No. 7-8, 21-32(1963).

The symptoms, pathological findings, and treatment of proctitis developing after radium therapy of cancer of the cervix of the uterus are discussed. Results are reported from a statistical study that shows a 16.4% reduction in this complication since 1950. A distinction was made between early radioepithelitis and secondary rectitis. (C.H.)

29452 SURGICAL TREATMENT OF RECTAL COMPLICATIONS DUE TO IRRADIATION OF THE SMALL PELVIS FOR CANCER OF THE UTERUS. M. Dargent. Arch. Maladies App. Digest. Maladies Nutr., 52: 33-52 (1963).

The surgical treatment of rectal complications due to radiotherapy of cancer of the uterus is discussed. Results are reported for 67 recto-vaginal fistulas and 31 rectal strictures following radium therapy treated by lymphadenectomy, colpo-hysterectomy, or by radiotherapy. Treatment by a large-scale sympathetic nerve operation to prevent pain in the acute stage of the cancer was carried out 19 times and was definitely successful when a purely dystrophic lesion was involved. Strictures and radionecrosis often affected the urinary system as well as the small intestine and sigmoid colon. Surgical corrective methods are described. (C.H.)

29453 HISTOLOGICAL ASPECTS OF RECTAL COMPLICATIONS DUE TO RADIOTHERAPY FOR CERVICAL CANCER. G. Gricouroff and F. Potet. Arch. Maladies App. Digest. Maladies Nutr., 52: 53-66(1963).

Rectal complications resulting from radium therapy of cervical cancers are discussed. Histological findings on 16 biopsies and anatomical specimens are described. (C.H.)

29454 CONCENTRATED PREOPERATIVE IRRADIATION THERAPY. Komei Nakayama, Fuminori Yanagisawa, Kinichi Nabeya, Tatsuo Tamiya, Seiichiro Kobayashi, and Kohji Makino (Univ. of Chiba, Japan). Arch. Surg., 87: 1003-18(Dec. 1963).

Experimental studies on the radiosensitivity of mouse tumors (ascites hepatoma MH 134 and Ehrlich ascites carcinoma) were conducted and correlated with clinical studies in 490 patients to determine whether or not the end results in treatment of carcinoma could be improved by altering tumor cells with preoperative radiation therapy. Mice bearing hepatomas grafted on to the tail demonstrated an inhibitory effect on both the primary lesion and the metastatic lesions after heavy x irradiation (2000 r) and that a lapse of time prior to therapy diminished the irradiation effect. In another group, Ehrlich ascites carcinoma was grafted in mice of the DD strain. Preoperative irradiation reduced the percentage of successful grafting and prolonged the retention of ascites. The inhibitory effect was most marked when 3000 r were given. On the basis of these results attempts were made to establish a practical and effective technique of preoperative irradiation therapy. A total dosage of 2000 r was given in divided doses of 700, 700, and 600 r consecutively on three days. Complications were few, and supplementary use of glucose solutions, amino acid mixtures, vitamins, and liver-protecting agents controlled untoward effects. It was established that a period of from four to seven days between the end of irradiation and surgical removal of tumor is optimal. A prolongation of survival time was seen, particularly in patients suffering from carcinoma of the upper and mid-thoracic esophagus, carcinoma of the breast, and cancer of the rectum. All cases of esophageal carcinoma resected in the absence of lymph node metastasis showed a 100% survival rate in the preoperative irradiation group, but not in the group treated only surgically. (BBB)

29455 ANIMAL EXPERIMENTS ON THE INFLUENCE OF HYPNOTICS AND SEDATIVES ON THE RADIOIODINE TEST. W. Bruns, G. Haeusler, and H. Kutzim (Universität, Cologne). Arzneimittel-Forsch., 13: 796-8(1963).

The influence of hypnotics and sedatives, methylphenobarbital, phenobarbital, glutethimide, thalidomide, and fluphenazine dihydrochloride, was studied in respect to ^{131}I storage by the thyroid gland as well as effects on

protein-bound ^{131}I ($PB^{131}I$) in the blood. Thiamazole was used as a control in the experimental scheme. Compared with the untreated control animals, methylphenobarbital, phenobarbital, and glutethimide produced a significant increase of radioactive iodine and $PB^{131}I$ uptake by the thyroid gland. Fluphenazine dihydrochloride and thiamazole reduced both iodine storage and $PB^{131}I$ values. No change in iodine storage by the thyroid was found with thalidomide but the $PB^{131}I$ value was significantly lowered. The significance of these findings in relation to the radioactive iodine test is pointed out. (Excerpta Med., Sect. XXIII, 1: No. 2, (Feb. 1964)).

29456 THE SITUATION OF CLINICAL APPLIANCE OF ISOTOPES IN NUCLEAR MEDICINE. R. W. Felten and H. W. Knipping (Kernforschungsanlage, Jülich, Ger.). Atomkernenergie, 9: 197-8(May-June 1964). (In German)

The improvement and refinement of radiodiagnosis of cancer and atheromatosis is being carried out. Of special value is the nearness to research reactors, which permits application of radionuclides of essentially shorter half life directly to patients and thus reduces the burden of radiation. Emphasis is being given to the further development of an early diagnosis of cancer. The "Gamma-Retina" is being used in the attempt to provide visual demonstration of rapidly moving diseased organs (image formation). Investigations for labeling the nucleus of carcinoma cells in body secretions also aim at an improvement of early cancer diagnosis. The latest results of isotope research are being used for clinical purposes, especially in the diagnosis and treatment of heart diseases and cancer. Studies concerning the atheromatotic alterations of the arteries of heart and brain are discussed along with the results in clinical treatment of liver and kidneys. (auth)

29457 EVALUATION OF RADIOCARDIOGRAPHIC TIME-ACTIVITY CURVES WITH AN ANALOGUE COMPUTER. PART I. A. Habermehl, E. H. Graul, G. Hagemann, H. Belzer, and H. Hundeshagen (Philipps-Universität, Marburg, Ger.). Atompraxis, 10: 246-9(May 1964). (In German)

A procedure is described for determining the residual volumes of the auricle and ventricle from the radiocardiographic activity-time functions measured in the patient, using an analog computer technique. The procedure is based on the congruence of the differential equations for the heart model and for an RC link. The evaluation instrument produces a tension impulse equivalent to the inflow function in the auricle. By varying two RC links, the input impulse is modified to make it correspond to the activity-time function measured over the ventricle. The residual volumes can be determined from the simple relations obtained by adjusting the resistance values. (auth)

29458 LOCALIZATION OF THE PLACENTA BY THE AID OF RADIOGRAPHY AND ISOTOPES IN THE DIAGNOSIS OF PLACENTA PREVIA. B. S. ten Berge. Berlin. Med., 11: 491-4(1960). (In German)

Comparative dosimetry studies were made of the radiologic and the radioisotope methods which are used to locate the placenta. A technique is described using ^{131}I-labeled human serum albumin injected intravenously. A 5-μC dose of this compound was adequate, and gave only a 0.02-r whole-body fetal radiation dose (compared with 0.8 to 1.0 r for each radiograph). The fetal thyroid dose with this much ^{131}I is somewhat higher, but well within permissible limits. (BBB)

29459 EXTRACORPOREAL IRRADIATION OF THE BLOOD: THE MATHEMATICAL PROBLEM OF DOSIMETRY. R. Oliver and B. J. Shepstone (Churchill Hospital, Oxford). Brit. J. Haematol., 10: 181-92(Apr. 1964).

Techniques for extracorporeal irradiation of human blood are reviewed. Dose limitations of extracorporeal irradiation as a therapeutic measure are discussed, and it is pointed out that calculations indicate little gain by increasing the dose received per transit above 100 to 150 rad. Mathematical formulas useful in considering exchange problems for different postulated values of a parameter are derived. (H.M.G.)

29460 LUNG CANCER IN A FLUORSPAR MINING COMMUNITY. I. RADIATION, DUST, AND MORTALITY EXPERIENCE. A. J. de Villiers and J. P. Windish (Dept. of National Health and Welfare, Ottawa). Brit. J. Ind. Med., 21: 94-109(Apr. 1964).

In the fluorspar mining community of St. Lawrence, Newfoundland, 23 of the 51 deaths that occurred in the period 1952-61 among employees with one or more years of underground mining experience were from lung cancer. The death rate from lung cancer is about 29 times that expected. The outstanding environmental finding in the fluorspar mines was the discovery of concentrations of Rn and daughter products in the air well in excess of suggested maximum permissible concentrations. Underground workers were probably exposed to an average potential α energy to complete decay of between 2.5 and 10 times the previously suggested working level of 1.3×10^5 Mev/l of air. These levels were obtained in mines in which no radioactive ore bodies were found. It is thus concluded that the immediate source of the Rn in the mine air was mine water. A comparison is made of atmospheric radioactivity in other mines, principally uranium mines, in relation to exposure levels of miners and incidence of lung cancer. (BBB)

29461 NEUTRON THERAPY. Brit. Med. J., 1: 1627 (June 22, 1963).

Historical developments and recent progress in the use of neutrons in the treatment of cancer are briefly reviewed. (BBB)

29462 THE BIOLOGY OF LYMPHOCYTIC CHORIOMENINGITIS INFECTION: VIRUS-INDUCED IMMUNE DISEASE. John Hotchin (New York State Dept. of Health, Albany). Cold Spring Harbor Symp. Quant. Biol., 27: 479-99(1962).

The effect of x irradiation was examined in a broader study to elucidate the nature of lymphocytic choriomeningitis (LCM), a naturally occurring virus disease of mice, from which the infection is occasionally transmitted to man. The hypothesis was examined that congenital LCM infection involves the development of a tolerance to the foreign microorganism during embryonic life. It was found that this virus-host system does indeed involve a form of latency which depends on the development of immunologic tolerance to the virus by the host. Pretreatment with x rays (200 to 800 r) caused marked protection of mice inoculated intracerebrally with LCM virus 24 hr later; the protection increased as dosage was raised to 500 r. After this point, the fully disease-protected animals died from the lethal effects of the irradiation. The relative absence of white cells from blood and concomitant freedom from disease in irradiated mice suggested that the lymphocytic infiltration of the tissues actually caused the clinical signs of LCM. This was further borne out by histologic study. A definite sparing effect was also found by treating infected mice with

large doses of cortisone. This evidence indicates that both the pathologic changes and clinical disease following LCM inoculation of adult mice occur as a direct result of the immune response, probably from its cellular component, and that the disease is eliminated if the immune response is suppressed. The results obtained with neonatal inoculation and amethopterin also showed that depression of immune response to LCM tended to eliminate disease and supported the concept of immune conflict as the main cause of disease. The relation of LCM to autoimmune disease is discussed. (BBB)

29463 CANCER OF CERVIX UTERI: LATE LOCAL RECURRENCE OR LATE RADIATION CANCER. John F. Hynes (St. Francis Hospital, Wilmington, Del.). Delaware Med. J., 35: 1-4(Jan. 1963).

Three cases of apparent radioinduced carcinoma are reported among 464 women treated between 1935 and 1956 with x rays and Ra for cervical cancer. The Ra dosage varied from 4500 to 6000 mg-hr in a single application of two or three days duration. Diagnosis of cancer was verified in every case by histologic examination, and it was strongly indicated that the cancer was radioinduced rather than recurrent. (BBB)

29464 HEPATOMA APPEARING 26 YEARS AFTER HEPATOGRAPHY WITH THOROTRAST. Mario Sposito and Vincenzo Albertini Petroni (Ospedale S. Giacomo in Augusta, Rome). Epatologia, 7: 159-74(May-June 1961). (In Italian)

A 46-yr-old woman was found to have a swollen and painful liver, shown later to be caused by a hepatoma, 26 yr after she had received an intravenous injectio: of 75 ml of a colloidal solution of ThO_2 (Thorotrast) to outline the liver blood vessels for diagnostic radiography. Biopsy of the liver showed the tumor cells as mono- and polynucleated liver epithelial cells dispersed in a reticular network of fibroblasts and scattered particles of ThO_2. A definite etiological relation of the Thorotrast deposits to liver neoplasia appears to be demonstrated in this case. The ThO_2 particles, taken up primarily by the liver Kupffer cells, induced a proliferation of connective tissue cells and chronic hepatitis, which formed the site of tumorigenesis. The spleen also became sclerotic as a result of fibrous tissue hyperplasia in response to the ThO_2 deposits in its reticuloendothelial cells. The literature relating to Thorotrast-induced neoplasia is briefly reviewed, and features of the present case compared with those of previously reported cases of hepatoma. (BBB)

29465 GAMMA-ENCEPHALOGRAPHY: A NEW RESEARCH METHOD IN NEUROLOGIC DIAGNOSIS. Gazz. Osped. Clin., 13: 216-27(Dec. 1961). (In Italian)

New techniques for brain scanning with γ-emitting isotopes are reviewed. (BBB)

29466 THE USES OF RADIOISOTOPES IN THE GERIATRIC PATIENT. George J. Meyer (Holy Cross Hospital, Fort Lauderdale, Fla.). Geriatrics, 19: 496-504(July 1964).

Radioisotopes are particularly helpful in the diagnosis of thyroid disorders, in many hematological problems, in some gastrointestinal abnormalities, in certain urological cases, and in occasional cardiovascular patients. Scintillation scanning will often provide useful information especially with respect to the thyroid gland, brain, liver, kidneys, and spleen. The most widely used radioisotopes for therapeutic purposes are cobalt-60, iodine-131, gold-198, and phosphorus-32. These are employed in the treatment of many different malignancies as well as certain non-neoplastic conditions. Applications of radioisotopes in geriatric medicine are discussed. (C.H.)

29467 CARCINOMA OF THYROID IN CHILDREN: RELATION TO PREVIOUS IRRADIATION. Nikolai Rachmaninoff (Harper Hospital, Detroit). Harper Hosp. Bull., 21: 166-71(Sept.-Oct. 1963).

The literature relating to thyroid cancer in children and its possible induction by ionizing radiations is reviewed, and seven cases of pediatric thyroid malignancy are reported, two of which had received neck irradiation. The review shows that in the last 60 years there has been a significant increase in the number of carcinomas of the thyroid gland in children, apparently not only due to better and earlier diagnosis but also possibly to some etiologic agent which induces thyroid neoplasia in the early age groups. During the 19th century there were only occasional reports of thyroid carcinoma in children. In the first decade of the 20th century no cases were reported: in the second decade there were three reports, in the third decade, five; and in the fourth decade, 34; and in the fifth decade, 50. About 25 to 30% of the children with thyroid tumor give a history of previous irradiation treatment to the neck area. In the new cases of carcinomas of thyroid in children studied, two had a history of prior irradiation for thymic enlargement. In these two patients prior irradiation was given at the ages of seven weeks and five years. The tumors developed 9 and 11 years later, at the ages of 9 years and 16 years respectively. In the younger patient, the histological pattern was follicular. In the 16-yr-old boy, the lesion was papillary and follicular and had metastasized to a cervical lymph node. In the 9-yr-old girl the tumor had apparently developed in a fetal adenoma which showed great cellularity, with tightly packed small glands in the peripheral portions and definite evidence of vascular invasion and thrombus formation. Both patients were living and well five years and six and one-half years later. The histological patterns and high incidence of vervical lymph node metastases in this series correspond to the findings reported in the literature; however, there were no pulmonary metastases and all patients are living and well. (BBB)

29468 CLINICAL AND EXPERIMENTAL ANIMAL STUDIES OF THE POSSIBILITIES OF PROPHYLAXIS AND THERAPY OF RADIOINDUCED SKIN CHANGES IN CONVENTIONAL DEPTH THERAPY. Erwin K. Schmidt (Universität, Munich). Hippokrates (Stuttgart), 33: 334-8 (Apr. 30, 1962). (In German)

Measures for increasing skin tolerance to radiation discussed are: filtration; restriction of blood circulation; dose fractionation; use of convergence radiation; and use of salves. (OTS)

29469 A STUDY OF RADIATION THERAPY IN VARIOUS SKIN DISEASES. I. OBSERVATIONS ON CLINICAL RESPONSE. Kimio Tasai (Hirosaki Univ., Japan). Hirosaki Igaku, 15: 503-11(Dec. 28, 1963). (In Japanese)

Clinical observations are reported on the effects and cutaneous damage from β rays (^{32}P and ^{90}Sr) and grenz rays given to 400 patients with skin diseases. In over 80% of cases with angioma simplex and angioma cavernosum (mainly strawberry marks) treated with β rays, a satisfactory response was seen, and there was no significant difference between results with ^{32}P and ^{90}Sr. Skin diseases which showed good response to grenz rays were: atopic dermatitis, neurodermitis, lichen Vidal, eczema chronicum, psoriasis vulgaris, verruca plana juvenilis, and pathologic granulation tissue. A total of 550 to 880 r was

used as the basic dose. Exceedingly high doses of 1000, 2000, and 5000 r of grenz rays were given to the fungus species Trichophyton gypseum, Trichophyton interdigitale, Epidermophyton floccosum, Trichophyton rubrum, and Candida albicans, but there was no difference discernible in growth and morphology between the irradiated group and the control. There were 15 cases of severe skin radiation injury over the last 12 years, the majority being seen in the period from 1958. The main source of skin damage was ^{60}Co. (BBB)

29470 A STUDY OF RADIATION THERAPY IN VARIOUS SKIN DISEASES. II. HISTOLOGICAL OBSERVATIONS OF THE SITES TREATED WITH BETA RAYS AND GRENZ RAYS. Kimio Tasai (Hirosaki Univ., Japan). Hirosaki Igaku, 15: 512-16(Dec. 28, 1963).

Serial biopsy specimens were taken from cases who received radiation therapy, including three patients with hemangioma, five with neurodermitis, and three with psoriasis vulgaris, and from white and black rabbits treated with β rays and grenz rays. In cases of hemangioma simplex treated with β rays (each time, 1000 μC of ^{32}P) over five times, there was seen: epidermal atrophy, increase in melanin pigment in the basal layer, reduction in size of the blood vessels, degeneration of the vessel walls, degeneration and fragmentation of connective tissue fibers, decrease in elastic fibers, and atrophy of sebaceous glands. The vascular lumens were reduced to minimum size after the 9th treatment, and degeneration of the vascular walls and atrophy of epidermis were maximal after the 12th. In the group treated with grenz rays (each time, 110 r), thinning of the epidermis and marked increase in melanin pigment in basal and prickle cell layers occurred when the radiotherapy was repeated three to five times. The appearance of melanophores became conspicuous in the 7th to the 10th course of radiotherapy, while elastic fibers increased after the 8th to the 10th irradiation but ceased after the 15th. In the experiments on β-ray and grenz-ray irradiation of rabbits, the results were essentially similar to the above results; the histologic changes were, however, more marked in black rabbits than in white ones. In general, damage of the tissue due to fractional radiation was less than that due to radiotherapy with a single high dose.

29471 NUCLEAR ENERGY AND CANCER. Roberto Affonso Placco (Instituto Adolfo Lutz, Itapetininga, Brazil). Hospital (Rio de Janeiro), 63: 1141-5(May 1963). (In Portuguese)

Comments on the development of atomic theory and nuclear energy are made. It is suggested that, owing to the fact that α and β rays can be deflected by a magnetic field deviation, the use of powerful electromagnets offer a possible therapeutic tool by which α and β radiations produced by radioisotopes used in the treatment of cancer could be deflected to prevent damage to healthy tissues. Some possible advantages of these radiations over x rays and neutrons in the radiotherapy of certain tumors are cited. (BBB)

29472 DOSE COMPARISON OF TWO TOTAL-BODY IRRADIATION FACILITIES. R. L. Hayes, T. H. Oddie, and M. Brucer (Oak Ridge Inst. of Nuclear Studies, Tenn.). Intern. J. Appl. Radiation Isotopes, 15: 313-18(June 1964).

An eight-beam ^{137}Cs total-body irradiation facility was found to be superior to an opposing-beam ^{60}Co unit even though ^{60}Co γ rays are more penetrating. The multibeam design gave an average absorbed dose that was essentially independent of body size, whereas the opposing-beam design gave results that varied by as much as 28%. (auth)

29473 THE TREATMENT OF MALIGNANT DISEASE OF THE EXTREMITIES BY MEGAVOLTAGE IRRADIATION UNDER TOURNIQUET ANOXIA. H. A. S. van den Brenk, J. P. Madigan, R. C. Kerr, N. M. Cass, and Wendy Richter (Cancer Inst. Board, Melbourne). J. Coll. Radiol. Australasia, 7: 142-58(Oct. 1963).

Theoretic and practical aspects of rendering both tumor and surrounding normal tissue anoxic prior to radiotherapy are discussed, and results in 13 cases are described. Precautions to be observed in the use of tourniquet anoxia, the best method for achieving complete deoxygenation in vivo, are identified. Irradiation techniques for megavoltage x-ray therapy of malignant tumors are described. Results suggest that tourniquet anoxia provides satisfactory curative qualities while reducing radiation damage to normal tissues. It is concluded that the technique merits further clinical trial evaluation. (TCO)

29474 LATE RESULTS OF THE IRRADIATION MENOPAUSE. Evan Shute (Shute Inst., London, Can.). J. Obstet. Gynaecol. Brit. Commonwealth, 70: 833-8(Oct. 1963).

The relative advantages, complications, and hazards of surgical and radiation induction of the menopause (by hysterectomy or pelvic irradiation with Ra or x rays) for the treatment of uterine bleeding at or near the menopause are discussed. Clinical data were compiled for 263 women submitted to radiation to induce the menopause. Complications arising from the irradiation are discussed and methods for treatment presented. (BBB)

29475 RADIUM SUBSTITUTES IN THE INTERSTITIAL IMPLANTATION OF TUMORS—WITH PARTICULAR REFERENCE TO IRIDIUM-192. Norman Simon (Mt. Sinai Hospital, New York). J. Oklahoma State Med. Assoc., 56: 371-6(Aug. 1963).

Hazards of radium use in different types of therapy are pointed out, and it is concluded that ^{192}Ir has considerable advantage over radium. Techniques for ^{192}Ir implantation, and advantages of its therapeutic use are discussed. (TCO)

29476 AN EXPERIMENTAL THERAPEUTIC APPROACH TO L1210 LEUKEMIA IN MICE: COMBINED CHEMOTHERAPY AND CENTRAL NERVOUS SYSTEM IRRADIATION. Ralph E. Johnson (National Cancer Inst., Bethesda, Md.). J. Natl. Cancer Inst., 32: 1333-41(June 1964).

Leukemia L1210 was inoculated intracranially into CDF_1 hybrid mice. After inoculation, the animals were randomized into test groups, but no treatment was initiated until day 4 to permit the disease to become systemic. The experimental approach combined systemic chemotherapy with Cytoxan (cyclophosphamide) and electron-beam irradiation of the entire cerebrospinal axis. The median survival for the untreated controls was 10 days. Survival was not significantly prolonged with irradiation alone and the maximum median survival with drug therapy alone at the optimal dosage was only 14 days. However, the combined therapy resulted in a highly significant prolongation of survival compared with that of mice treated with either drug or irradiation alone. It also produced 70 percent apparent cures (60-day survivors). The potential clinical application of such combined treatment is discussed. (auth)

29477 COMPLICATIONS ASSOCIATED WITH SUPERVOLTAGE IRRADIATION FOR MALIGNANT TUMORS OF THE FEMALE REPRODUCTIVE SYSTEM. Kenneth J. Parham (Medical Coll. of South Carolina, Charleston). J. S. Carolina Med. Assoc., 59: 241-5(July 1963).

Advantages and disadvantages, and the comparative incidence of complications, with 2-Mev and conventional

(250-kv) x-ray therapy are examined with reference to 182 patients treated by the supervoltage method. The most frequently occurring minor complication was a mild diarrhea which was generally controlled by paregoric and Kaopectate. Among the severe complications, vaginal stenosis occurred in 55 patients out of 105 who experienced complications; all but one case occurring in patients receiving more than 4000 r. By use of proper psychologic handling of these patients as well as the maintenance of an adequate food and fluid intake, the frequently associated systemic roentgen reaction or roentgen sickness was allayed. This was generally controlled by pyridoxine and Dramamine, the most favorable prophylactic factor being the use of proper psychologic handling. (BBB)

29478 SURGERY AND RADIOTHERAPY IN UROLOGY. Eric Riches (Middlesex Hospital, London). J. Urol., 90: 339-50(Oct. 1963).

Results in the treatment of 113 cases of bladder cancer with supervoltage x rays, combined in some instances with surgery or interstitial irradiation, are described, with particular reference to the complications of radiotherapy. It is concluded that supervoltage therapy is not good salvage treatment for the hopeless case except in palliative doses. (BBB)

29479 RADICAL CYSTECTOMY AFTER SUPERVOLTAGE RADIOTHERAPY. Gerald N. Hecker, Clarence V. Hodges, Robert J. Moore, and Robert Higgins (Univ. of Oregon, Portland). J. Urol., 91: 256-60(Mar. 1964).

Methods for preventing serious complications in combined cystectomy and irradiation for bladder cancer are described with reference to 16 cases. It is concluded that radical cystectomy following supervoltage therapy can be performed with a relatively low mortality rate by limiting the radiation to the bladder only, use of a longitudinal incision, sectioning of ureters at the pelvic brim, and use of abdominal retention sutures. (BBB)

29480 CHROMOSOME DAMAGE AFTER X-RAY THERAPY. J. Wahrman and E. Robinson (Hebrew Univ., Jerusalem). Lancet, 1: 505-6(Mar. 2, 1963).

Maintenance for prolonged periods of time of acentric chromosome fractions was studied. Diploid cells were not found in blood cultures examined 15 and 20 months after the last x-ray treatment. Moreover, these cultures contained a high proportion of chromosome types which are not usually perpetuated in a series of mitotic cycles. Acentric fragments were exceedingly common in these cultures, up to six in one cell. Acentrics and chromatid breaks are generally accepted as evidence of recent breakage events, but unless damaged nuclei are able to remain dormant for years and subsequently enter a mitotic phase, they cannot be considered as the immediate result of x-ray treatment. It is therefore suggested that the mammalian organism may occasionally maintain factors inducing continuous chromosome breakages such as: gene mutations, virus infections, chemical compounds produced by irradiation, or by leukemic conditions. A brief survey made of data relating to chromosome anomalies occurring after radiotherapy, with reference to possible induction of leukemia indicates that a large fraction of the chromosome damage caused by radiation is rapidly eliminated. (BBB)

29481 TREATMENT OF ANKYLOSING SPONDYLITIS. Lancet, 2: 703-4(Oct. 6, 1962).

The use of ionizing radiation to treat ankylosing spondylitis is discussed in view of reports of induction of leukemia as a late sequel. It was shown that the mortality rate from leukemia among patients with ankylosing spondylitis treated with radiotherapy was greater than that among the general population, and another comparison of the records of irradiated and unirradiated patients showed an increased death rate from leukemia in the treated group only. A more extended survey which analyzed the records of 13,352 patients treated for ankylosing spondylitis with radiotherapy confirmed the increased death rate from leukemia. The latent period between irradiation and development of leukemia usually seemed to be between three and five years. Also, it was suggested that, for low doses of irradiation, the incidence of leukemia was directly proportional to the dose, and that there was no threshold dose for the induction of the disease. The risk appears also directly related to the age at exposure. Chromosomal anomalies in patients with ankylosing spondylitis are reviewed. (BBB)

29482 RADIOISOTOPE LOCALIZATION FOR RENAL BIOPSY. G. A. Posen, M. Kaye, and L. Rosenthal (Montreal General Hospital). Lancet, 1: 1043(May 9, 1964).

Misconceptions regarding radioisotope scanning hazards are clarified, and a statement by Telfer et al., that maximal count rate determination over each kidney after neohydrin-^{203}Hg injection will yield the functional capacity is scrutinized. (TCO)

29483 IMMUNOLOGICAL METHOD OF INCREASING THE SENSITIVITY OF PRIMARY SARCOMAS TO LOCAL IRRADIATION WITH X-RAYS. Annabelle Cohen (Johannesburg General Hospital). Lancet, 1: 1163(May 23, 1963).

Investigations into the radiobiology of the C3H mammary adenocarcinoma tumor-host system are reported. The tumor, a radioresistant one with an LD_{50} of 5700 rad in the standard isogenic situation, was treated in situ in mice protected from scattered radiation by a lead shield through which the tumor protruded. The curative dose was shown to be a relative property dependent upon the host's state of resistance to its tumor—this dose could be significantly shifted in either direction, within certain limits, by introducing experimental variables into the host-tumor relation. When small fragments of tumor were irradiated in vitro before implantation, isografts arising from such fragments, which were still viable after sublethal attenuation doses, showed a significantly increased radiosensitivity when afterwards treated in situ, apparently owing to some host-resistance mechanism induced by the attenuation procedure. The feasibility of increasing the radiosentivity of established mammary tumors by eliciting subliminal systemic immune responses in these normally unresponsive isogenic and autogenous host-tumor systems was also explored. The irradiated immunizing inoculum was found to be more effective when given before local treatment. Radiosensitizing efficacy was shown to fall off sharply with attenuation doses above the optimal range. By contrast with this C3H mammary tumor, the characteristic feature of most hydrocarbon-induced sarcomas is the relative ease with which they can evoke tumor-immune states. This finding is ascribed to the concomitant mutagenic action of the carcinogen on the target cells, the resultant neoplasms being antigenically divergent, in varying degrees, from the normal tissues of the host. (BBB)

29484 OBSERVATIONS ON DEUTERIUM TREATMENT OF A VIRUS-INDUCED MOUSE LEUKEMIA. Benjamin V. Siegel (Univ. of Oregon, Portland). Life Sci., 3: 261-6 (Mar. 1964).

The effects of D_2O, administered as 15 or 30% of the drinking water, on a virus-induced mouse leukemia were studied. To study the temporal relation between tumor virus inoculation and commencement of therapy, D_2O treat-

ment was initiated on the same day (t_0) as viral inoculation or on days 7 (t_7), 14 (t_{14}), 21 (t_{21}), or 28 (t_{28}) subsequent to infection. The end-point was taken at 58 days, since at that point 80% of the infected animals not treated with D_2O had already died. Administration of 30% D_2O did not influence body weight or appear to be toxic to the animals. A significantly increased survival at 30 and 58 days was noted in mice subjected to 30% heavy water at t_0 and t_7. T_{21} deuterated mouse survival was similar to control animals at 30 days but showed an increased survival of ~20% by 58 days. When 15% D_2O was begun at t_0, survival at 30 and 58 days was greater than in H_2O-controls but less than in the 30%-D_2O group. As has been pointed out earlier, mice supplied with drinking water of 15 atom % D content are deuterated to 13 to 14% as compared to 23 to 25% deuteration of mice on a 30% D regimen. It is suggested that the increased survival number or survival time of deuterated mice could be the result of interference with mitosis, or, the D effect might be accomplished by some injury or destruction of the tumor cell rather than by suppressing cell division. Alternatively, deuteration may have been inhibitory to the virus and/or to the induced neoplastic cell. The greater beneficial results with earlier treatments of the mice following viral inoculation, rather than later when the leukemic disease was established, suggests a possible antileukemia virus activity by D_2O. (BBB)

29485 THERAPEUTIC USES OF RADIOACTIVE ISOTOPES (LAST OF FOUR ARTICLES ON RADIOACTIVE ISOTOPES IN MEDICINE). Robert J. Dickson (London Clinic). London Clinic Med. J., 5: 67-77(Jan. 1964).

Some applications of radioactive isotopes in the treatment of malignant disease are discussed. Various techniques employing Ra, ^{60}Co, ^{137}Cs, ^{182}Ta, ^{192}Ir, ^{198}Au, ^{32}P, ^{90}Y, ^{90}Sr, ^{131}I, ^{24}Na, and ^{82}Br are outlined, and their advantages, disadvantages, and hazards are discussed. Some experimental uses of radioisotopes, in particular for lymphangiography, intravascular injections, and selective uptake studies, are also discussed. (BBB)

29486 SEVERE ACCIDENTS SECONDARY TO IRRADIATION OF CANCER OF THE LARYNX: RADIONECROSIS. J. Guell Revert. Med. Clin. (Barcelona), 41: 48-66(July 1963). (In Spanish)

A doctoral thesis relating to sequelae of radiotherapy is summarized, but no new data are presented in this article. (BBB)

29487 CONTRAINDICATED PROCEDURES IN PREGNANCY. J. Breitner (Frauenklinik Muetterheim vom Roten Kreuz, Munich). Med. Klin. (Munich), 58: 1610-3 (Sept. 27, 1963). (In German)

The dangers involved in the use of ionizing radiation, as well as certain drugs and other agents, in the diagnosis and treatment of diseases in pregnant women are discussed. Radiodiagnostic methods should be avoided especially during the first months of gestation when injury or teratogenesis is most likely to occur as a result of exposure of the embryo. (BBB)

29488 CLINICAL ASPECTS AND AETIOLOGY OF BONE SARCOMA. G. Ott and P. Ehlers (Universität, Heidelberg). Med. Welt, 38: 1907-15(1963).

Sarcomas of bone give much information on the etiology of malignant tumors. Clinically and morphologically, they are characterized by extreme variability. Classification is according to histological-histogenetic principles. For statistical study they may be divided into osteogenic, myelogenic, and parosteal sarcomas. Some forms, such as round-cell and polymorph-cell sarcomas of the skeleton, do not readily fit into this classification and are therefore assembled in a separate group, the rest group. From 1925 to 1961 a total of 194 sarcomas of bone were treated in the surgical clinic of Heidelberg University. These observations showed numerous statistical, clinical, and prognostic peculiarities of these tumors. The frequency of bone sarcomas is approximately the same in men and women, and they are considerably more frequent in young people. These juvenile sarcomas of bone appear to become more frequent in recent years, as indicated by the present study. The increase in frequency is related to the accumulation of ^{90}Sr in the bones, especially of children and adolescents. Osteogenic sarcomas are the most frequent primary malignant tumors of bone (60%). Some 40% of all bone sarcomas originate from the distal end of the femur and the proximal end of the tibia. This preference is probably due to the fact that these are the parts where growth is the most pronounced. The chance of malignant degeneration appears to parallel the rate of proliferation of the cells. Some 10% of cases occurred on the basis of demonstrable presarcomatous diseases. In this, the following are involved: benign tumors of the skeleton, x ray irradiation, chronic osteomyelitis, and sometimes foreign bodies and bone marrow transplantation. The incorporation of radioactive isotopes with a tendency to accumulate in the bones is sometimes decisive for the occurrence of these tumors (bone sarcomas in painters of luminous watch dials, and the very frequent bone sarcomas in children with TB of the bones or joints treated with peteosthor). A trauma is rarely involved in the genesis of bone sarcomas. Usually, the onset of the disease is characterized by rheumatic pains, demonstration of a tumor is less often the case and pathological fracture or demonstration of metastases is rare. The BSR is often increased, other hematological findings are usually normal. The fatal cases terminated in 21 mo, on the average, though the clinical course was very variable. Late metastases are definitely rare; in some highly differentiated bone sarcomas the course may sometimes take many years or even decades. Preferably, treatment should consist of surgery. In the above-mentioned clinic the 5-year recovery rate was 31.9%, though on first clinical examination metastases were already found in 17% of cases. If metastases are present the chance of recovery decreases considerably, the more so since metastasization of these tumors is mainly hematogenic and into the lungs. The prognosis is very unfavorable if the primary tumor is localized in the spine, the skull, or the pelvis, since in this case radical surgical treatment is usually impossible. The prognosis of sarcomas of the head of the tibia was strikingly unfavorable, while the prognosis of distal femoral sarcomas was good (5-year recovery rate of 53.8%), if treatment was appropriate. The prognosis of osteogenic sarcomas is considerably better than that of myelogenic and parosteal sarcomas. The clinical statistics of a surgical clinic offer many advantages for studies on bone sarcomas, even in comparison with centrally gathered statistics. Usually, only the surgeon observes the onset, course, treatment, and recovery of these patients. Therefore, clinical cancer statistics, especially from surgical clinics, will continue to give indispensable information on the general problem of cancer. (Excerpta Med., Sect. XXIII, 1: No. 3, (March 1964)).

29489 PURPOSE AND RESULTS OF PRE-OPERATIVE IRRADIATION. H. L. Keller. Med. Welt, 38: 1915-20 (1963).

The purpose of pre-operative irradiation consists of re-

ducing the size of the primary tumor; devitalization of the tumor cells and, consequently, protection against hematogenic spread of viable tumor cells through the body during the operation; prevention of local recurrence, and treatment of the local lymphatic system. The indication for preoperative irradiation becomes stringent if the tumor is in a clinically advanced state. Total dosage, given in the usual fractionated doses, should not be excessive, in view of the operation and wound healing. A dose of some 3,000 r is recommended. An interval of 7 to 10 days between irradiation and operation is considered suitable, since then the effect of radiation on the tumor has reached a maximum. The results of preoperative irradiation are discussed for cancer of the breast, oesophageal carcinoma, and cancer of the rectum. If the indication, dosage and technique are correct the method improves late results. (Excerpta Med., Sect. XXIII, 1: No. 3, (March 1964)).

29490 CLINICAL ASPECTS OF RADIATION. Gerrit L. Hekhuis (School of Aerospace Medicine, Brooks AFB, Tex.). Military Med., 126: 674-6(Sept. 1961).

Clinical symptoms resulting from whole-body exposure at 3 dose levels (sub-, mid-, and supralethal) are reviewed. (BBB)

29491 THE NUCLEAR AGE AND NURSING TECHNOLOGY. Lenore Simon (National Naval Medical Center, Bethesda, Md.). Military Med., 126: 701-6(Sept. 1961).

Medical applications for radioisotopes are briefly reviewed, and other nuclear age problems discussed, to illustrate the necessity for expanding nursing curricula so that essential educational needs may be met. (BBB)

29492 REACTION OF THE LYMPHATIC AND BLOOD VESSELS OF THE UTERUS TO ENDOCAVITARY RADIOTHERAPY. G. Bassani (Università, Modena, Italy). G. C. Setti, B. Brunelli, and S. Sacchi. Minerva Med., 3: 169-75 (Apr. 1961).

The condition of the lymph network and blood vessels is described for radiation doses of 10,000 to 12,000 r, 15,000 r, and above 20,000 r. Color photographs show uterine lymph and blood vessels filled with injection masses. (TCO)

29493 CRITICAL CONSIDERATIONS ON SURGICAL AND RADIOSURGICAL TREATMENT OF CARCINOMA OF THE VOCAL CORDS. K. Jatho. Monatsschr. Ohrenheilk. [Laryngo-Rhinol.], 97: 210-20(1963).

The methods of choice for laryngological treatment of unilateral carcinomas of the vocal cords are chordectomy with laryngeal fissure, which can be done by cricothyreotomy to obtain a better view, contact irradiation with radium. Equally good results have been obtained by radiological therapy, by means of tele-x-ray irradiation. A combination of contact irradiation with the tele-x-ray method is Hörbst-Ruckensteiner short-distance irradiation with surgical preparation of the field of irradiation. Chordectomy, the most frequently used laryngological routine method, is superior to radium contact irradiation, since the shape and function of the vocal cords are maintained and the voice is usually unimpaired. Complications such as delayed wound healing or early and late perichondritis were not observed with this method. A detailed description is given. (Excerpta Med., Sect. XXIII, 1: No. 3, (March 1964)).

29494 RADIATION INJURIES OF THE URINARY TRACT. V. Hoffmann (Universität, Cologne). Muench. Med. Wochschr., 104: 2485-8(Dec. 21, 1962). (In German)

Radiation treatment of genital carcinomas in women has increased the incidence of radiation injuries to the adjacent pelvic organ of the urinary tract. In 20 to 25% of an irradiated group free of recurrent ovarian carcinoma, urologic complications were observed. Five cases are described where urological findings are correlated with radiation exposure. Appearance of the radiation symptoms was insidious. They may occur from six months to as much as 10 yr after radiation. (BBB)

29495 SAFE PROCEDURES IN MEDICAL RADIATION. [A PANEL DISCUSSION]. Norman Simon (Mt. Sinai Hospital, New York), Hanson Blatz, John Roach, John H. Harley, William B. Seaman, Marshall Brucer, Charles L. Dunham, Shields Warren, and Henry Quastler. N. Y. State J. Med., 64: 963-75(Apr. 15, 1964).

The radiation health program in New York City, which requires the registration of every radiation source, is described. Some comments on safety measures in diagnostic radiology are made, especially from the point of view of reducing gonadal and somatic dose levels. It is emphasized that the physician must know the meaning and significance of such things as primary radiation, secondary radiation, effective filtration, distance, volume of tissue, and other factors; and that he must have a broad but detailed knowledge of the diagnostic information which can be reasonably expected from each examination. A summary of the present status of radiation exposure from fallout indicates that young children, who accumulate the largest concentrations, are showing about 3 mμC of ^{90}Sr/g Ca in the bone. In terms of the levels set by the Federal Radiation Council for peaceful applications, these levels still would be about a $\frac{1}{20}$ of what is considered all right for the general population. Over the next few years this level may double or even triple, from the amounts of ^{90}Sr now in the atmosphere. Another survey of hazards involved in diagnostic radiology shows that the major portion of the genetically significant radiation dose that originates from medical sources is probably from fluoroscopic examinations. Other topics discussed by the nine participants were: the possible dangers of reactors situated near populous communities, indications for x-ray pelvimetry in pregnant women, poor standards of radiation hygiene among general practitioners, use of ^{131}I in treatment of hyperthyroidism, and evidence for radiation leukemogenesis. (BBB)

29496 THE VALUE OF IRRADIATION THERAPY IN PRIMARY OVARIAN CARCINOMA. Louis J. Wilkie (St. Joseph's Hospital, Omaha, Neb.). Nebraska State Med. J., 48: 315-21(June 1963).

The therapeutic results are recorded and the relative advantages cited for the ^{60}Co treatment of ovarian cancer, with reference to 15 cases. The advantages of supravoltage ^{60}Co γ radiation over 200- to 300-kvp x-ray treatment are listed. In 15 patients treated with ^{60}Co γ, there were eight survivals and seven deaths; of the survivals two had clinical evidence of disease, but the six others showed no signs of recurrent tumor six to 42 months later. (BBB)

29497 PRENATAL ORIGIN OF CHILDHOOD LEUKEMIA: EVIDENCE FROM TWINS. Brian MacMahon and Morton A. Levy (Harvard School of Public Health, Boston). New Engl. J. Med., 270: 1082-5(May 21, 1964).

Current hypotheses of the etiology of childhood leukemia, especially those relating leukemia to chromosomal damage and those implicating leukemogenic agents, are discussed. Two hypotheses are distinguished by the assumed time of origin of the etiologic agent. A study of affected twins was made to determine which of these two hypotheses seems

potentially the more fruitful at the present time. A series of 72 twin sets selected in which at least one member was affected by leukemia in childhood. In five sets both members were affected. The concordance rate for like-sex sets in this series was 1:9, which is much higher than is currently recognized. Although only two sets were thoroughly investigated, it seemed probable that all five were monozygous, bringing the concordance rate for monozygous sets in these data to about 25%. The implications of these high concordance rates both to the counseling of parents of affected twins and to hypotheses regarding the time of origin of childhood leukemia are discussed. (BBB)

29498 A STUDY ON THE SALIVARY EXCRETION OF RADIOACTIVE IODINE IN VARIOUS THYROID FUNCTION STATES. Kyung Ho Park (Seoul National Univ., Korea). New Med. J., (Seoul, Korea), 6: 35-42(1963). (In Korean)

The salivary excretion of radioactive iodine was studied in 87 cases of euthyroidism, 89 cases of hyperthyroidism and 24 cases of hypothyroidism. Twenty-four and forty-eight hours after the administration of tracer dose, radioactivities of saliva, and plasma protein bound iodine (PBI) were measured and the results were expressed in salivary iodine percent dose per liter, saliva-plasma ^{131}I ratio and saliva-PB^{131}I ratio. The characteristics of these studies were compared with thyroid uptake of radioiodine and PB^{131}I conversion ratio. Salivary iodine percent dose per liter was extremely decreased in hyperthyroid state and increased with the decrease of thyroid activity. From these results, it was found that data from 24 hours saliva was more reliable to evaluate the thyroid function states, compared with that of 48 hours. The results from saliva-plasma ^{131}I ratio and saliva-PB^{131}I ratio reflect also the various thyroid function states favorably, and the overlapping of the ranges between euthyroidism, and hypothyroidism was less frequently encountered in data from 48 hours saliva-plasma ^{131}I ratio. All data obtained from salivary studies revealed the inverse relationship to the thyroid uptake of ^{131}I and may be satisfactory for the evaluation of thyroid function as a convenient method. For the screening of large population, salivary iodine percent dose per liter of 24 hours is simple and rapid in its procedure and rather convenient to evaluate the diagnostic accuracy. (auth)

29499 EFFECT OF THE PREOPERATIVE IRRADIATION AND SUBCUTANEOUS CANCER TISSUE IMPLANTATION ON ANTITUMOR ANTIBODY LEVELS. REPORT I. Jun Makidono (Makidono Radiology Clinic., Hiroshima). Nippon Igaku Hoshasen Gakkai Zasshi, 22: 897-904(Nov. 25, 1962).

In five patients with cancer of the stomach, the development or change in titer of serum antitumor antibodies was followed after pre- and postoperative radiotherapy. The antigen was prepared from homogenized tumor tissue, obtained at surgery, and was fractionated by centrifugation (3000 rpm for 5 min) into a supernatant (A) and sedimented (B) fraction. Serum antibodies were detected by three methods: a ring precipitation test, complement-fixation test, and a tanned sheep cell agglutination test. Although negative results were obtained with the first two tests, with the third test a rise in serum antibodies was seen in all five patients after preoperative irradiation. The antigen was present mainly in the supernatant tumor fraction. In several patients in whom excised tumor was reimplanted in the same subject, an additional rise in sheep-cell-agglutinating antibody was seen. Postoperative radiotherapy also elevated the titers in most cases. Further examination of the tumor homogenates used for the antigen showed that when the A (supernatant) fraction was centrifuged at 40,000 g, the activity resided in the supernatant again. Autoimmune aspects of cancer are discussed, with emphasis on the therapeutic possibilities of use of autologous tumors for immunization. (BBB)

29500 THE INFLUENCE OF HYPOTHERMIC CONDITIONS ON THE RADIOSENSITIVITY OF YOSHIDA ASCITES SARCOMA CELLS IN VITRO. Tadashi Nakamura, Takeo Okuyama, Kiyohiko Sakamoto, Masatoshi Sakka, and Tadashi Adachi (Tokyo Medical and Dental Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 22: 1131-4(Jan. 25, 1963).

Yoshida sarcoma cells in the ascites form were obtained from the ascites fluid of rats inoculated 5 days earlier. X irradiation in vitro was conducted in glass tubes in which sarcoma cells were suspended to give a dose rate at the center of the tube of 250 r/min and a dose of 1500 r in a single exposure. Irradiations of sarcoma cells were done under three different environmental temperatures, the first at room temperature (18°C), the second at 0°C, and the last at −10°C. Glass tubes containing sarcoma cells were immersed in the cooling medium for about five min before irradiation and then irradiated under these conditions for six min. In the first two groups, air was insufflated into the ascites fluid but this procedure was not possible during irradiation at −10°C because the suspending medium was frozen. No difference was observed between median survival times for two unirradiated groups subjected to the conditions of hypothermia (−10°C) and room temperature. The tumorcidal effect of irradiation was evident in the three irradiated groups by the longer survival time of animals which were transplanted with sarcoma cells receiving 1500 r than those inoculated with unirradiated sarcoma cells. Radiosensitivity of sarcoma cells was markedly influenced by the low temperature at the time of irradiation. The median survival time of rats inoculated with cells irradiated at −10°, 0°, and 18°C was 13.0, 15.9, and 19.5 days, compared with 7.6 days in rats inoculated with unirradiated cells. It is suggested that the oxygen concentration in tumor cells may be affected by thermal conditions during irradiation so that chemical reactions which may induce radiation damage in sarcoma cells are depressed by low temperature. (BBB)

29501 LOCAL BONE MARROW CHANGES FOLLOWING THERAPEUTIC TELECOBALT IRRADIATION. I. THE CHANGES AFTER 3000-r IRRADIATION. Tatsuya Kurashina (Tohoku Univ., Sendai). Nippon Igaku Hoshasen Gakkai Zasshi, 22: 1334-45(Mar. 25, 1963). (In Japanese)

Sternal marrow changes were studied during radiation therapy. Initial marrow aspirations and peripheral blood examinations were performed prior to irradiation, after different doses, and at the completion of therapy. After local 3000-r, 180-kv x irradiation of 11 patients with various malignant tumors the results in sternal marrow were as follows: total nucleated cell count was reduced to 8%; myeloblasts, basophilic proerythroblasts, erythroblasts, megakaryocytes, and mitotic figures disappeared; normoblasts and immature leucocytes also almost disappeared; lymphocytes and mature neutrophils were moderately reduced in number and considerable morphologic change was noted; reticuloendothelial cells showed no morphologic changes, and seemed to be the most radioresistant among the bone marrow cells; the marrow smears were uniformly hypocellular but the change of the amount of fat was slight; it was suggested that the sternal marrow after 3000-r irradiation will remain hypoplastic and complete recovery will never occur. The changes in the peripheral blood was as follows: the leucocyte count was reduced by half (from 9400 to 4700/mm^3), while the erythrocyte

count hardly showed any change; and neutrophils and lymphocytes both decreased in the absolute counts and both played a leading part in the leucopenia. (BBB)

29502 SCANNING AUTOMATIC ISODOSE PLOTTER. Yoichiro Umegaki (National Cancer Center, Tokyo) and Masaomi Takizawa. Nippon Igaku Hoshasen Gakkai Zasshi, 23: 205-9(May 25, 1963). (In Japanese)

The design of a scanning-type automatic isodose plotter, a device used to plot an isodose curve automatically with minimum effort, is presented. The machine is constructed to combine three units: an ordinary scintiscanner, dosimeter with a percentage discriminator (the output of the dosimeter is connected to a specially made meter relay system), recorder (the puncher of the scanner is used for this purpose). A fully remote-controlled recording system is thus obtained. Some isodose curves plotted by this machine are illustrated, showing diagrams useful for both ^{60}Co γ-radiation and x-ray therapeutic applications. (BBB)

29503 SYMPOSIUM ON NEW DIAGNOSTIC PROCEDURES IN INTERNAL MEDICINE. I. CLINICAL APPLICATIONS OF IN VIVO COUNTING. Teruo Nagai (National Inst. of Radiological Sciences, Chiba, Japan). Nippon Naika Gakkai Zasshi, 52: 590-7(Sept. 10, 1963). (In Japanese)

New clinical techniques employing ^{131}I, ^{40}K, and ^{22}Na are discussed. (BBB)

29504 CLINICAL USES OF RADIOISOTOPES IN ROUTINE EXAMINATIONS: SOME EXPERIMENTAL STUDIES ON CIRCUITS OF THE INSTRUMENTS. H. Akagi. Nippon Naika Gakkai Zasshi, 52: 598-9(Sept. 10, 1963). (In Japanese)

Instrumentation for detection and counting of γ-emitting isotopes used in clinical diagnosis is discussed. (BBB)

29505 AN ATTEMPT AT EVALUATION OF RADIOSENSITIVITY OF CANCER OF THE CERVIX UTERI BY MEANS OF SOME CYTOCHEMICAL REACTIONS. J. Skalska-Vorbrodt and H. Starkiewicz-Tenner (Inst. of Oncology, Gliwice, Poland). Nowotwory, 13: 209-17(1963).

A series of vaginal smears of patients suffering from cancer of cervix uteri before and after radium therapy were studied. Reactions on nucleic acids and acid and alkaline phosphatases were performed and the pictures obtained were compared with preparations stained by means of Papanicolaou's method. Differences were found in the intensity of reactions to nucleic acids in different cases of cancer before as well as after irradiation and increase of intensity of reactions to phosphatase after irradiation. In some cases a correlation was found between the behavior of the reaction to nucleic acids and the clinical course of the disease. (Excerpta Med., Sect. XXIII, 1: No. 3, (March 1964)).

29506 KIDNEY TUMORS AND IRRADIATION PATHOGENESIS OF KIDNEY TUMORS IN IRRADIATED RATS. C. C. Berdjis (Fort Detrick, Frederick, Md.). Oncologia, 16: 312-24(1963).

The histopathogenesis and frequency of renal tumors in normal and irradiated rats of the Sprague-Dawley and FAC-F_1 hybrid Fischer strains are reported. The irradiated rats were exposed to either whole-body 500-r, unilateral renal 900-r, or bilateral renal 2 × 500-r doses of 250-kv x rays. They were observed for one to two years. Neither the controls nor the irradiated animals dying before one year showed any renal neoplasms. A few controls (5–10%) and over 50% of irradiated rats developed nephrosclerosis and varying degrees of arteriosclerotic changes affecting both kidneys. About 35% of FAC-F_1 strain and 38% of the Sprague-Dawley rats developed cortical tumors of one or both kidneys. In comparing these findings with those of man and mice, it appears that the rat is most susceptible to kidney tumors. Arteriosclerotic changes and nephrosclerosis, found in all rats with renal tumors, seemed to be intimately related to the radiation-induced tumors. Age was also a primary factor in inducing kidney tumors in irradiated animals but was not a factor in control animals even when arteriosclerosis was present. It is suggested that precocious senescence induced by irradiation is responsible for engendering the kidney tumors in irradiated animals. Both sexes were equally affected in both rats and mice. (BBB)

29507 SEVERE IRRADIATION DURING ODONTOGENESIS: REPORT OF A CASE. Robert J. Gorlin and Lawrence H. Meskin (Univ. of Minnesota, Minneapolis). Oral Surg. Oral Med. Oral Pathol., 16: 35-8(Jan. 1963).

The case history of a 17-yr-old girl is described, showing severe abnormalities in tooth development resulting from intensive radiotherapy over the facial area during infancy. It is concluded on the basis of findings in this and similar cases that irradiation of susceptible dental structures during their period of development may result in complete anodontia, hypodontia, microdontia, dwarfing of roots, and premature completion of calcification resulting in enamel hypoplasia. (BBB)

29508 OSTEOMYELITIS AND OSTEORADIONECROSIS: REPORT OF TWO CASES. Thomas J. Cook (Jackson Memorial Hospital, Miami, Fla.). Oral Surg. Oral Med. Oral Pathol., 16: 257-60(Mar. 1963).

History of the development of osteoradionecrosis and its successful treatment, with reference to one case, are described. It is concluded that necrosis of the jaw is a calculated risk when irradiation therapy is given for intraoral carcinoma if teeth are present. (BBB)

29509 ANEMIA, CANCER, AND RADIATIONS. E. Chisale (Ospedali Galliera, Genoa). Pathologica, 55: 85-90 (Mar.-Apr. 1963). (In Italian)

Published work concerning the occurrence of anemia as a sign of cancer and the influence of radiation on it are reviewed. (BBB)

29510 CHANGES IN THE PERIPHERAL BLOOD DUE TO RADIOTHERAPY FOR LYMPHOGRANULOMATOSIS. B. Bratkowska-Seniow and S. Gruszka (Medical Academy, Wroclaw, Poland). Polskie Arch. Med. Wewnetrznej, 33: 243-6(1963). (In Polish)

The results of blood counts are reported for 38 cases of lymphogranulomatosis treated with x rays in 85 cases of irradiation. Various doses (600 to 8000 r) were employed, depending on the location and extent of the granulomatous lesions. Such treatment did not alter the erythrocyte count, but leucopenia occurred twice as frequently as before treatment and was not accompanied by neutropenia. In cases with pathologic hyperleukocytosis the treatment caused the normalization of the total white cell count as well as of the differential count. Eosinophilia was less frequently seen in these cases ss compared to reports in the literature data. Eosinophilia is more likely due to progression of the malignant disease or to therapeutic liver extract administration. The differential white cell count was not influenced by radiation treatment. (BBB)

29511 THERAPEUTIC PRECAUTIONS WITH THE PREGNANT WOMAN. P. Chassagne. Presse Med., 71: 1075-8(Apr. 27, 1963). (In French)

The hazards arising from the use of drugs and exposure

to ionizing radiation during pregnancy are discussed. (BBB)

29512 DIAGNOSIS OF PLACENTA PREVIA WITH RADIOACTIVE ISOTOPES. Bryan M. Hibbard (Univ. of Liverpool). Proc. Roy. Soc. Med., 55: 640-2(Aug. 1962).

The relative advantages of isotope and x-ray methods of placental localization are discussed, and a method is described which reduces the radiation hazard to mother and fetus. (BBB)

29513 THE PLACE OF CESIUM-137 IN RADIOTHERAPY. C. Botstein and R. J. Schulz (Montefiore Hospital, New York). Progr. Radiation Therapy, 2: 67-83(1962).

The historical development of ^{137}Cs as a γ-ray source for radiotherapy is briefly reviewed, and the relative advantages of ^{137}Cs as compared with orthovoltage x rays enumerated. The effect of the ^{134}Cs contaminant, initially causing the output to fall at a slightly greater rate than due to the decay of ^{137}Cs alone, is discussed, and the output measurements on one unit made with a condenser ionization chamber are reported. Shielding requirements are examined and special features of Cs teletherapy which affect treatment planning are outlined. Clinical experience with 238 patients is reviewed. It is concluded that ^{137}Cs can, to great advantage, completely replace orthovoltage equipment and supplement very well a large ^{60}Co unit. (BBB)

29514 RADIATION AND SURGERY. Fernando G. Bloedorn (Univ. of Maryland, Baltimore). Progr. Radiation Therapy, 2: 114-36(1962).

Radiobiological and clinical aspects of radiotherapy combined with surgical techniques are discussed, with consideration of the prevention of complications in surgically manipulated irradiated tissue. It is emphasized that both modalities of therapy should be applied with an integral radical approach. (BBB)

29515 THE INFLUENCE OF ALKYLHYDROPEROXIDES ON RESPIRATION AND ANAEROBIC GLYCOLYSIS OF ASCITES-TUMOR CELLS. R. Moritz and M. Schulz (Universitats-Geschwulstklinik der Charite, Berlin and Institut fur Organische Chemie der Deutschen Akademie der Wissenschaften, Berlin). Radiobiol. Radiotherap., 5: 353-63(1964). (In German)

The influence of simple alkylhydroperoxides (methyl-, ethyl-, n-propyl-, n-butyl-, tert-butyl-, cumol-, benzyl- and tetrahydrofurane-hydroperoxide) on the energy metabolism of ascites tumor cells of mouse was examined. The findings were compared with the effects obtained by x irradiation. It follows that the inhibitory effects of alkylhydroperoxides are in several points not identical with those effects obtained by x irradiation. Type and size of alkyl substituents had in these experiments no significant influence on the metabolic inhibitory effects. It will be concluded from the experiments that similarly built alkylhydroperoxides cannot play any important part in radiation injury. (auth)

29516 THE CHANGE OF TRANSAMINASE-(SGOT)-ACTIVITY OF WOMEN SUFFERING FROM CARCINOMA DURING X-IRRADIATION. M. Paâl, S. Csoemoer, J. Doemoetoeri, and M. Szinnyai (Medical Univ., Budapest). Radiobiol. Radiotherap., 5: 373-8(1964). (In German)

The determination of serum-glutamic acid-oxalacetic acid-transaminase-(SGOT)-activity was performed on untreated persons suffering from carcinoma, operated persons suffering from carcinoma, patients being in an incurable stage, and female patients suffering from benign tumor. In the majority of cases the SGOT-activity was pathologically high in untreated carcinoma patients. Between the spreading of process and the enzyme activity no connection was found, the incurable very progressed cases, however, gave the highest values. During irradiation generally no characteristic increase of enzyme activity occurred. In radium therapy using a relatively high radiation dose an increase of enzyme activity occurred from time to time. (auth)

29517 CONTROLS FOLLOWING RADIATION TREATMENT OF ARTERIAL BLOCKING DISEASES. R. Barke, K. Roeder, and W. Oelssner (Karl-Marx-Universität, Leipzig). Radiol. Diagn., 5: 183-8(1964). (In German)

Radiation treatment of the sympathetic nervous system was employed in the treatment of vascular diseases. Angiographic findings before and after irradiation were compared with clinical results. Radioinduced changes in the sympathetic nerves are discussed. (C.H.)

29518 QUANTITATIVE AND QUALITATIVE ASPECTS OF THE EFFECTS OF RADIATIONS ON NORMAL AND MALIGNANT MAMMALIAN CELLS. Anna Goldfeder (Francis Delafield Hospital, New York). Radiol. Interam., 1: 1-8 (June 1962). (In Spanish)

Previous results of morphologic changes in irradiated animal tumor cells are reviewed and some general conclusions drawn. A significant variation was seen in radiosensitivity among cells, normal and malignant, not only of different types but of the same morphologic classification. The rate of reproducibility and the capacity to differentiate are the two main factors which influence the cellular response to radiation. The anomalies of cell division following irradiation are manifest in the clumping and stickiness of chromosomes, chromatin bridge-formation in anaphase, uneven distribution of chromosomes in cell division, as well as cytoplasmic changes such as vacuolation, fragmentation of Golgi apparatus, swelling of mitochondria, and eosinophilia. The huge amorphous nuclei (shown in electronmicrographs), the unipolar anaphase, and double anaphase noted were not previously described. Qualitative cellular abnormalities are similar following irradiation either in vitro or in situ. However, there is a quantitative difference in the dosage requirements: it was shown that to prevent growth of tissue cells in vitro much larger radiation doses are required than for cellular growth in situ. It is suggested that the intrinsic dynamic properties of the cell play a prominent part in the rate of cell recovery following irradiation which is also a contributing factor in estimating their radiosensitivity. This conclusion is based on results obtained from studies on the relative metabolic behavior of two types of tumors by the use of ^{32}P. It was noted that the histologic picture of the tumor removed at the 7th or 8th day after irradiation gives a good indication of the overall effectiveness of a given dose of radiations. (BBB)

29519 DOSIMETRIC STUDY FOR THE IMPLANTATION OF CYLINDERS CONTAINING YTTRIUM-90 IN THE HYPOPHYSIS. G. Juliani (Università, Turin). Radiol. Med., 49: 650-68(1963).

In interstitial hypophysial β-therapy using ^{90}Y, estimation of the dose based only on the overall activity of the preparations may lead to markedly erroneous deductions. It is, instead, desirable to be able to determine the volume of the portion of hypophysis reached by doses sufficient to cause complete destruction. A description is given of a simple method allowing this estimation in cases where cylindrical sources of ^{90}Y are used. The determinations can be considered sufficiently correct if a single preparation only is implanted, or if two or more sources are ar-

ranged on the same plane. When two or more sources are implanted in different planes, calculation of the dose becomes more complicated and, at the same time, imprecise. It is suggested that spherical sources, in small number and of fairly high activity, are the most suitable. This technique should guarantee not only greater uniformity in the distribution of the dose, but also a more accurate estimation of the latter. (Excerpta Med., Sect. XXIII, 1: No. 1, (Jan. 1964)).

29520 TRAINING IN NUCLEAR MEDICINE FOR RADIOLOGY RESIDENTS. Kenneth R. McCormack (Univ. of California, San Francisco). Radiology, 83: 22-5(July 1964).

Although physicians from many specialty backgrounds are involved in the application of radioisotope technics, radiology is the only specialty board that requires specific training and gives separate examination and certification in nuclear medicine. A questionnaire survey of all institutions having approved residency programs in radiology was undertaken to determine what training is being given in nuclear medicine. Some institutions are giving up to six months training, while many have no program of their own and rely on other institutions for this phase of the residency training. The accumulated data in regard to basic, clinical diagnostic, and clinical therapeutic training were tabulated and are discussed. The deficiencies in many programs in meeting the minimum board eligibility and Atomic Energy Commission licensure requirements are apparent from the data. With the increasing expansion of radioisotope technics, it is proposed that all approved programs should meet the minimum stated training requirements. It is further proposed that radiology should assume the lead and establish nuclear medicine on a basis equal to that of diagnostic roentgenology and therapeutic radiology. (auth)

29521 LYMPHOMAS: RELATIONSHIP BETWEEN DOSAGE AND RECURRENCE. Melville L. Jacobs and Fred J. Marasso (City of Hope Medical Center, Duarte, Calif.). Radiology, 83: 106-7(July 1964).

The treatment of lymphoma has steadily improved and survival rates have risen over the past half century. This is due primarily to the advent of high-energy radiation. The relation between the quantity of radiation delivered to localized areas and the recurrences in those fields is reviewed. Data are summarized on 185 patients with a diagnosis of lymphoma who underwent radiation treatment. The cases are classified as Hodgkin's disease (103 cases), lymphosarcoma (56 cases), and reticulum-cell sarcoma. A 5-yr-survival of 18.5% is reported. (C.H.)

29522 PREOPERATIVE IRRADIATION: EVALUATION BY A SIMPLE EXPERIMENTAL MODEL. Bernard H. Feder and Phyllis B. Blair (Veterans Administration Hospital, Long Beach, Calif.). Radiology, 83: 111-19(July 1964).

Preoperative irradiation, in less than cancerocidal doses, significantly reduces the transplantability of a C3H rhabdomyosarcoma to a C3H mouse. Successful transplants occur in at least 95 per cent of the recipients when a surgical needle is drawn once through the unirradiated donor tumor and then once through the recipient's thigh. If the donor tumor is first given 2,000 r, air (i.e., less than half the probable cancerocidal dose) the appearance of successful transplants is delayed and their number is reduced by one-fourth or more. Larger doses further decrease transplantability. Following irradiation of the donor tumor with 2,000 r, the effect upon transplantability is the same whether the tumors are transplanted shortly or after delays of up to one week. The finding that transplantability can be significantly decreased by irradiation at dose levels far lower than those cancerocidal for the in situ tumor is consistent with the clinical data of Stearns, Deddish, and Quan which showed improved salvage in Dukes' C cancer of the rectum following small doses of preoperative irradiation. The finding that the definite decrease in transplantability observed after preoperative irradiation may not be influenced by varying the interval between irradiation and transplantation within specified limits suggests that it may be useful in certain instances to administer small-to-moderate doses of radiation while the patient awaits surgery. The role of preoperative irradiation in the management of human cancer can be established only by carefully controlled clinical experiments. (auth)

29523 METHOD OF BONE RADIOAUTOGRAPHY (PHOSPHORUS-32). TECHNIQUE AND EXPERIMENTAL SIGNIFICANCE. D. Guilmet, M. Dubrasquet, and S. Bonfils. Rev. Franc. Etudes Clin. Biol., 8: 717-21(1963).

The method of organ autoradiography (^{32}P) on thick sections is applicable to bones. The technique was applied in 10 rats and 16 dogs, transverse sections being taken from the femoral diaphyses normal, fractured, or grafted. The amount injected was of the magnitude of 160 microcuries per kg/weight, the animal being sacrificed 30 min thereafter. In the normal bone, the bone marrow takes up the major part of ^{32}P and must be enucleated in order to obtain accurate images of the cortex. Spongy cals as well as grafts pick up ^{32}P very intensely even after several months. Osseous sequestrae, on the contrary, do not pick up any radioactivity. The relationship between the fixation of ^{32}P on the one hand, and vascular and metabolic disorders on the other hand, is briefly discussed. (Excerpta Med., Sect. XXIII, 1: No. 2, (Feb. 1964)).

29524 CELLS AND CANCER TISSUES. III. IMMUNOGENETIC ASPECTS; GRAFTS OF CANCER. J.-L. Amiel and G. Mathe (Hôpital Saint Louis, Paris). Rev. Praticien, 13: 1057-64(Apr. 1, 1963). (In French)

Immunologic responses to cancer cells are reviewed, including the effects of whole-body irradiation of the host on cancer grafting. (BBB)

29525 INVESTIGATIONS OF THE PROBABLE GONADAL DOSES RECEIVED BY THE POPULATION OF PAVIA IN X-RAY DIAGNOSTIC EXAMINATIONS. M. Garofano and V. Molina (Universitâ, Pavia, Italy). Riv. Ital. Ig., 21: 420-6(Sept.-Oct. 1961). (In Italian)

The amount of radiation to the gonads received by the population of Pavia during 1959 as a result of x-ray diagnostic examinations performed with 21 units in the community was calculated from information recorded at all units. Included in records were sex of the person and type of examination performed; 21 categories of examinations were used. Each inhabitant underwent 0.3 (mean) examinations within the period of testing, men more often than women. In both sexes the most frequent use was radioscopy of the thorax, followed by stratigraphy of the thorax. The percentages of these are respectively 39.71% and 14.64% for men and 43.74% and 9.98% for women. The other uses are tabulated, giving sex, examinations per 1000 persons, percentage of all examinations, gonadal dose per examination (mrem), and gonadal dose per person regardless of age and fertility (mrem) for each category. The mean total dose per inhabitant regardless of age and fertility status was calculated to be 59.39 mrem. The number of examinations per inhabitant in Pavia is higher than the value for other parts of Italy and is equal to the value for England.

The largest gonadal doses occur in examination of the lumbar column, urography, and fluoroscopic examinations. Various portions of the data are compared with corresponding information for other countries, notably the United States. (BBB)

29526 RADIOACTIVE IODINE IN PULMONARY EMPHYSEMA. Morris H. Levine and Allan Hurst (Univ. of Colorado, Denver). Rocky Mt. Med. J., 60: 35-6(Sept. 1963).

A new method for treating emphysema is proposed which involves the use of ^{131}I to establish a hypothyroid condition and thereby reduce the body oxygen requirement. It was evident from the results that in most cases, ^{131}I therapy contributed something to the patients' improvement, whether enduring or transient. In several instances the results were dramatic. It is suggested that after all of the usual types of therapy have been utilized and little else remains, the use of ^{131}I therapy should be considered. (BBB)

29527 PRELIMINARY OBSERVATIONS IN CESIUM-137 TELETHERAPY. Robert J. Reeves and Boyd T. Worde (Duke Univ., Durham, N. C.). Southern Med. J., 57: 379-85 (Apr. 1964).

The relative advantages of ^{137}Cs as a radiation source and results of its use for teletherapy in 276 patients, with particular respect to optimal dosage and complications, are described. (BBB)

29528 RADIATION AND LUNG CANCER. Gordon C. Johnson (Univ. of Miami, Fla.). Southern Med. J., 57: 473-81(Apr. 1964).

The variations in tumor radiosensitivity, suggested tumor-sterilizing doses, and resulting complications of radiotherapy of different types of lung cancer are discussed, and a survey made of reported therapeutic results. Preoperative irradiation, as a possible means of improving cure rates by combining the effectiveness of radiation with that of surgery, is also discussed. A program for radiation therapy is proposed and presented in tabular form, showing dosage and schedules recommended for various histologic types and extension of tumor. (BBB)

29529 ON THE AXIS DOSE DETERMINATION OF Co^{60} PENDULUM IRRADIATION. Gerd Hagemann and Rene du Mesnil de Rochemont (Universität, Marburg/Lahn, Ger.). Strahlentherapie, 124: 16-21(May 1964). (In German)

A method for fast, simple, and exact determination of the axis dose of ^{60}Co pendulum therapy is discussed. Without any calculation the irradiation time for obtaining a desirable dose can be found: rectangular lines are drawn on graph paper. Considering given values for pendulum angle, field size, desirable dose, and activity of the cobalt source at the time of irradiation, the irradiation time for a measured pendulum width of the patient is obtained at the end of the lines. (auth)

29530 A PRACTICAL METHOD OF CALCULATING IN A PRECISE MANNER THE DOSE AT DIFFERENT DEPTHS OF TISSUE AT THE CENTER OF THE BEAM OF IONIZING RADIATION. Jean-Marc Légaré (Hôpital Queen Elizabeth, Montreal). Strahlentherapie, 124: 22-32(May 1964). (In German)

A practical and accurate method of calculating the tissue exposure dose along the central axis of the beam is presented. The method, based on the use of tissue/air ratios, is applicable to x-ray machines as well as to ^{60}Co and ^{137}Cs units. The method was applied to situations where the SCD and the FSD are 75 and 60 cm respectively. (auth)

29531 THE GEOMETRIC CONSTRUCTION OF RECTANGULAR IRRADIATION FIELD FROM STANDARD FIELD ELEMENTS (FORMULAS FOR CALCULATION OF DOSE DISTRIBUTION). Manfred Busch (Universität, Freiburg i. B.). Strahlentherapie, 124: 54-9(May 1964). (In German)

Equations for calculations of dose distributions of rectangular irradiation fields under standard conditions are given. The calculation is based on the dose distribution of a standard field unit. Using a source skin distance of 60 cm, the size of the standard field unit is 1 cm^2. The equations were developed for computer use only, they are not suitable for manual calculations. The value of the dose error, resulting from the use of this method, is discussed. (auth)

29532 THE TREATMENT OF RETINOBLASTOMAS AND MELANOBLASTOMAS OF THE UVEA BY IMPLANTATION OF RADIOACTIVE COBALT WIRES. Franco Fossati. Strahlentherapie, 124: 180-97(June 1964). (In German)

An implantation technique for radioactive cobalt wires used for the treatment of retinoblastomas and melanoblastomas of the uvea is described and dose estimations are reported. The clinical results obtained in 7 cases of retinoblastoma, in 15 cases of melanoblastoma of the uvea, and in 2 cases of angiomatosis retinae progredita are described. (auth)

29533 IMMUNOELECTROPHORETIC INVESTIGATIONS OF THE SERUM ALBUMIN PICTURE AND IMMUNE GLOBULIN DEFICIENCY IN TUMOR PATIENTS UNDER RADIATION TREATMENT. Wolfram Kempt (Universität, Frankfurt am Main). Strahlentherapie, 124: 219-31(June 1964). (In German)

Serum of 70 patients with tumors was investigated immunoelectrophoretically. The results showed a less intense albumin line, and more intense α_1-antitrypsine-, ceruloplasmine-, α_2-macroglobulin-, and β_{2B}-globulin (= β_{1C}-globulin = C_3'-complement)-lines. Observing the time course of 43 cases, tumor irradiation had no influence upon the immunoelectropherogram, which was already primarily very pathological. The main γ-fraction was determined paper-electrophoretically. β_{2A} (= γ_{1A})- and β_{2M} (= γ_{BM})- immune globulin were obtained separately by the use of specific antisera. Tumor irradiation alone did not cause hypo- or gamma-globulinemia, or defects in the β_2-immune globulins. Immune globulin deficiency was observed occasionally in the case of generalized tumor incidence of the lymphoreticular system and after prolonged treatment with cytostatics. In all tumor cases with a clinical antibody deficiency an antibiotic treatment combined with a substituting treatment with gamma globulin is recommended. (auth)

29534 ON SOME AUTORADIOGRAPHIC OBSERVATIONS AFTER INHALATION OF RADIOACTIVE YTTRIUM AND ZIRCONIUM. Ingeborg Schmidtke, Liselotte Blattner, and Walter Schiessle (Universität, Freiburg i. B.). Strahlentherapie, 124: 232-41(June 1964). (In German)

Autoradiographic observations of the respiratory tract of guinea pigs after inhalation of radioactive yttrium and zirconium are reported. A prolonged retention occurred not only in the pulmonary tissue but also in the radiation-sensitive regional lymph nodes. (auth)

29535 EXPERIMENTAL INVESTIGATIONS ON INFLUENCING THE GROWTH OF EHRLICH TUMORS OF MICE BY X-RAY IRRADIATION OF TUMOR SURROUNDINGS. Willi-Ernst Adam and Challio Yenprapine (Universität, Erlangen-Nurnberg, Ger.). Strahlentherapie, 124: 254-60(June 1964). (In German)

The growth inhibiting effect of indirect irradiation upon the tumor which is frequently described in literature and confirmed by radiobiological experiments is in contradiction to the clinical requirements for saving the healthy tissue surrounding the tumor. To solve this problem, the environment of tumors located in the body trunk of mice was irradiated with 1 × 3000 r or 5 × 1000 r, respectively, shielding the tumor with lead. In all cases the tumors, whose environment was irradiated, grew faster than the ones of the control animals. The results confirm the justification of the clinical requirement for concentration of the radiation dose to the tumor and for saving the healthy environment. (auth)

29536 CARBON-COATED PREPARATIONS WITH MIXED Au^{198} AND Ag^{111} ISOTOPES FOR MEDICAL USE. N. B. Micheev, H. Fouad, and A. A. Abdel-Rassoul (Atomic Energy Establishment, Inchass, Egypt). Strahlentherapie, 124: 308-10(June 1964).

Carrier free silver-111 was deposited quantitatively on carbon particles previously containing ^{198}Au. A method is described for producing both preparations of carbon suspensions with mixed ^{198}Au and ^{111}Ag activities and those with ^{111}Ag on inactive gold-on-carbon for therapeutic application. (auth)

29537 UV THERAPY AND ITS RADIOBIOLOGICAL BASIS (ARTIFICIAL RADIATION SOURCES). Albert Boeni (Universität, Zurich). Strahlentherapie, 124: 311-17(June 1964). (In German)

The difficulties occurring with medical UV-therapy are pointed out: instruments for UV-irradiation are constructed by physical-technical view points and the dosimetry is based only on development and intensity of the erythema. Some biological effects of the UV-light important for medicine are discussed. UV-irradiation is able to increase the ratio between organic phosphate and oxygen and, therefore, to increase the consumption of oxygen. The peripheral circulation can be increased by production of H-substances or by destroying cholinesterase. The increase of serum oxydase by UV can probably raise the cycle of autoimmunization. The decrease of alkaline phosphatase by UV can have a favourable influence upon certain inflammatory factors. The possibility that new enzymes can be synthesized during UV-treatment is pointed out. (auth)

29538 RADIOIODINE-125 FOR EVALUATION OF THYROID FUNCTION. Prentiss M. Dettman and William G. Myers (Ohio State Univ., Columbus). Surg. Forum, 12: 17-19(1961).

The advantages of ^{125}I in comparison with ^{131}I for evaluation of thyroid gland function are considered. A primary advantage is the possibility of providing the same information with less radiation exposure when ^{125}I is used, and studies were undertaken to substantiate this hypothesis. Eight patients with widespread cancer that did not involve the thyroid gland were chosen to simulate normal individuals with respect to thyroid function. Two patients, who had surgical thyroid disease and were more than 45 years old, were studied to demonstrate specific applicability of ^{125}I in surgery. Satisfactory scans were obtained when only 5 μC of ^{125}I were used, whereas comparable pictures obtained with ^{131}I required a dose of 50 to 100 μC. The patient serves as his own control, and the rate of uptake is determined by serial counts. The detector is reproducibly brought close to the anterior neck repeatedly during the first few hours after an oral dose of iodide labeled with ^{125}I. Less than 0.1 μC is usually required to give satisfactory results and the radiation exposure is <0.01 rad. (BBB)

29539 CLINICAL REACTIONS AFTER TELECOBALT IRRADIATION IN COMPARISON TO 200-kv THERAPY. Werner Bohndorf (Universität, Wurzburg, Ger.). Therapie Gegenwart, 101: 536-9(Nov. 1962). (In German)

The complications and side-effects of cancer treatment with ^{60}Co γ radiation are enumerated and contrasted to those occurring after conventional 200-kv x-ray therapy. The feet of 8-day-old chicks irradiated with 1200-, 1400-, and 1600-r doses of either ^{60}Co γ or x rays showed that bone in developmental stages is much less vulnerable to γ radiation (bone injury was greater after a 1200-r dose of x rays than after a 1600-r dose of γ rays). A major advantage of ^{60}Co radiotherapy is the more favorable subjective response of the patient than after equivalent dosage roentgen irradiation; moreover, hematopoietic depression after γ irradiation is less marked because of the lower effective absorbed dose to the bone marrow. Unpublished experiments conducted in rabbits receiving daily 150- to 200-r doses in the neck region to give total doses of 8100 r, showed that practically the same reactions occurred in lymph nodes after ^{60}Co as after x irradiation. On the basis of clinical and experimental observations, and other reports in the literature, it is concluded that ultra-hard radiation definitely represents an advancement in the radiotherapy of certain types of tumors. (BBB)

29540 HEPATIC INJURY FOLLOWING IRRADIATION: A MORPHOLOGIC STUDY. Kikuaki Ogata, Kazuo Hizawa, Masashi Yoshida, Tadao Kitamuro, Go Akagi, Ko Kagawa, and Fukuhei Fukuda (Tokushima Univ., Japan). Tokushima J. Exptl. Med., 9: 240-51(Feb. 1963).

A review of the literature showed that there is no agreement on the morphologic changes of the liver induced by ionizing radiation. Many of the hepatic changes described previously are regarded to be of secondary character due to pathologic processes occurring in other organs. In attempts to clarify whether hepatic injury due to irradiation is primary or secondary, material for examination was obtained from three autopsied cases, two of which had primary, and one had a secondary cancer of the lung. The common distribution of characteristic lesions observed in the three cases indicated that irradiation played a large role in causing such changes in the liver. The three cases also showed relatively severe anemia, leucocytopenia, and poor general condition. Based upon the findings of severe fibrotic changes in the lung found in all three cases, it is conclued that such changes in the lung accelerated the hepatic changes. However, radiation was considered the most important factor in the development of hepatic lesions. To confirm that the hepatic changes induced by irradiation are of primary character, experimental work is required. (BBB)

29541 RADIATION MYELOPATHY. John B. Dynes (Lahey Clinic, Boston). Trans. Am. Neurol. Assoc., 85: 51-5(1960).

Development of neurologic complications in cancer patients treated with supervoltage (2-Mev) x rays is reported. For a variety of carcinomas, involving the head, neck, chest, and mediastinum, 1100 patients were treated with doses of 4800 to 6000 r. In most patients no signs or symptoms of nervous system disorder developed, but symptoms did develop in two groups of patients. The factors of importance in the development of myelopathy seem to be the dosage of radiation, the rate or intensity of application, and shielding or failure to shield the spinal cord,

plus the important individual sensitivity factor. It is suggested that the best way to prevent the radiation myelopathies is to shield the spinal cord. An interposing rotating protecting rod of either gold or lead is now used on all rotating fields where the cord dose would be expected to reach 4000 r or more. This device makes it possible to protect all patients, except those who have an unusual sensitivity to radiation. (BBB)

29542 ON ELECTROPHORETIC STUDIES OF SERUM PROTEINS IN PULMONARY DISEASES WITH REFERENCE TO X-RAY INJURY AND CORTICOSTEROID TREATMENT. Klaus Waterstradt (Fachklinik Wildeshausen der Landesversicherungsanstalt, Oldenburg, Ger.). Tuberkulosearzt, 16: 129-36(Mar. 1962). (In German)

Electrophoretic analyses of serum proteins were carried out with the view of studying the diagnostic value of this method in carcinoma and Boeck's sarcoid of the lung and assessing the effects of x irradiation on the serum protein fractions. It was found that a positive Kessel test, in which triple staining of electropherograms is used to evaluate proteins, lipoproteins, and glycoproteins, constitutes proof of carcinoma only if the results of the three tests are concordant; a marked reduction of the α-lipoprotein fraction suggests carcinoma; and some diagnostic value attaches to changes in the proportion of the protein fractions. Hypergammaglobulinemia is the most sensitive indicator of Boeck's sarcoid and was demonstrable in all 37 cases. There was no difference as regards normalization of the serum protein fractions between patients who had been cured by a combination of prednisolone and chemotherapy or chemotherapy only and those with spontaneous regression of the lesion. Prolonged irradiation in the course of diagnostic x-ray examinations (minimum of 10 exposures) was followed after 20 hr by an increase in the albumin fraction (average rise 1.5) and a reduction in the γ-globulin fraction (average fall 2.3 percentage units). No change was noted in the α_1-, α_2-, and β-globulin fractions after repeated radiographic exposure of the lung. (BBB)

29543 EFFECT OF NEUTRONS AND X RAYS ON EHRLICH ASCITES TUMOR CELLS. Giovanni Silini and Shirley Hornsey (Centro Studi Nucleari della Casaccia, Rome and Hammersmith Hospital, London). Tumori, 50: 3-12(Jan.-Feb. 1964). (In Italian)

The sensitivity of a tetraploid strain of Ehrlich ascites tumor cells to two different types of ionizing radiation was studied. The tumor cells were irradiated in vitro in suspensions equilibrated with oxygen or nitrogen. The irradiated cells were then serially diluted and the dilutions inoculated subcutaneously in neonatal mice. Survival of the cells after irradiation was evaluated from the TD_{50} (tumor dose-50%), the number of cells required to produce tumors in half of the mice. Survival curves were thus obtained after irradiation with 200-kv x rays and with fast neutrons (6-Mev) in the presence and absence of oxygen. The oxygen-enhancement ratio for x rays is 3:1 and for fast neutrons 1:8. The RBE of fast neutrons relative to 200-kv x rays for loss of reproductive integrity is 2:1 in oxygen and 3:6 in nitrogen. The radiosensitivity of a hyperdiploid strain as defined by the slope of the exponential part of the survival curves is the same when the irradiations are carried out in oxygen. Splitting of the total dose into two fractions given at various times resulted in an increase of the surviving fraction of the cells compared to those which received the total dose in one single dose. The rate of recovery appeared to be similar for the two radiations used, and recovery was at its maximum 5 to 7 hr after the first dose. It is concluded that the repair process is basically the same in x- and neutron-irradiated cells, and suggested that this experimental model should be applicable to the study of solid tumors as well. (BBB)

29544 ON THE GENESIS OF LATE ANEMIA FOLLOWING RADIOTHERAPY. H. Huber and N. Shirakura (Universitat, Innsbruck, Austria). Wien. Z. Inn. Med. Grenzg., 44: 115-21(Feb. 1963). (In German)

In addition to the postirradiation dose-related reduction of red cell precursors in bone marrow and the subsequent thrombopenia there is also an increased peripheral cell reduction with shortened erythrocyte survival. True aplastic anemia is infrequent and at low radiation dosages the marrow soon recovers. Even though the marrow shows increased erythropoiesis, erythrocyte survival is reduced. Red cell survival times were measured with ^{51}Cr in 25 patients who were treated 6 to 12 years previously with x ray for uterine carcinoma and who were clinically free of recurrence. The erythrocyte survival time was less than 24 days in 9 of the patients. In 8 of these cases there were some changes in blood volume and some blood loss. There was no correlation between hemoglobin values and erythrocyte survival times. Anemias are not infrequent after radiation treatment for uterine tumors. From one group of 204 patients who were irradiated more than five yr previously 3% had anemia. This was fatal for two of the patients. A slightly shortened erythrocyte survival is not sufficient to account for this anemia and it may be due to a limited potential or reduced ability of the marrow to compensate for this loss. Accelerated destruction of erythrocytes is a factor that contributes to the anemia seen after radiation exposure, but it begs the question to simply designate these cells as hemolytic. This and other symptomatic anemias may be related to decreased marrow reserve and overproduction of short-lived erythrocytes. The results of the study indicate that the ^{51}Cr method for survival time measurement is limited in its ability to demonstrate marrow regenerative capacity and erythrocyte destruction. (BBB)

29545 LIVER INJURIES CAUSED BY X-RAY THERAPY FOLLOWING TOTAL NEPHRECTOMY FOR GRAWITZI CARCINOMA OF THE RIGHT KIDNEY. Vladimir Frydl and Miloslav Schrottenbaum (District Hospital, Teplice, Czechoslovakia). Z. Aertzl. Fortbild., 56: 1155-9 (Nov. 1, 1962). (In German)

A 64-yr-old woman was treated with 3000 r of x radiation following removal of the right kidney for Grawitz-type carcinoma. Morphological findings showed widespread atrophy of the right lobe of the liver. The changes found suggested a type of Budd-Chiari syndrome. The case illustrated not only the regenerative power of the liver, but also the serious injuries that can result from radiation to the region of the liver. (BBB)

29546 THOROTRAST INJURY WITH REFERENCE TO THERAPY AND EXPERT TESTIMONY. G. Kittel (Universitat, Erlangen-Nuernberg, Ger.). Z. Laryngol., Rhinol., Otol., 42: 38-49(Jan. 1963). (In German)

Late complications resulting from the clinical diagnostic radiologic use of Thorotrast, an aqueous suspension of ThO_2 (consisting mainly of the isotopes ^{228}Th and ^{232}Th), as a radio-opaque material are considered. The literature is reviewed and two new cases presented, with clinical, radiologic, and histologic findings. The two case reports underline the various ways in which the multiple nerve lesions may be present after the usual long latent period. The medico-legal aspects of Thorotrast injury are discussed, especially with regard to assessment of the

percentage of disability as a basis for legal settlements. (BBB)

29547 STATISTICAL REPORT ON MALIGNANT TUMORS AFTER X-RAY OR RADIUM CASTRATION. P. Goecke and P. Stueper (Universität, Münster, Ger.). Zentr. Gynaekol., 83: 194-9(Feb. 4, 1961). (In German)

Analysis of genital carcinoma after Ra or x radiation of 65 cases over the period from 1940 to 1960 gives contradictory indications as to whether these tumors were radioinduced. Compared to the other genital carcinomas, the tendency toward corpus carcinoma after a castration dose exhibited by the material available can be explained only in part by an altered age structure. However, evidence is strongly in favor of radioinduction at least to some extent. Risks of radioinduced and surgical castration are compared. (H.M.G.)

29548 ON THE MECHANISM OF ACTION OF X RAYS AND CYTOSTATIC SUBSTANCES IN TUMOR CELLS. H. Maass (Universität, Hamburg). Zentr. Gynaekol., 85: 209-16(Feb. 16, 1963). (In German)

The lethal action of x rays on tumor cells is probably due to a reduction of diphosphopyridine nucleotide (DPN) concentration and decrease in DNA synthesis. Less is known about the action sites of cytostatic agents that are used for their ability to combine with a wide variety of cell constituents. These combinations may result in inhibition of DPN synthesis and glycolysis. The DPN concentration can be increased by addition of B vitamins or nicotinamide. Inhibition of tumor growth in annuals sometimes can be prevented by nicotinamide. Protein synthesis is also affected, even though glycolysis takes place and adenosine triphosphate (ATP) and DPN levels are normal. Glycolysis can proceed at a normal rate if nicotinamide is present, even with high concentrations of cytostatic agents, but protein synthesis may be practically stopped. Cytostatic agents, unlike x ray, affect protein synthesis directly. It is not known which effects of cytostatic agents are responsible for tumor growth inhibition, but it is doubtful whether it is an effect resulting from decreased DPN concentration. Cytostatic agents affect tumor cells and also normal cells, but until the basis for malignant growth is explained, it will be very difficult to find agents that affect tumor cells specifically. Since cytostatic agents affect all cells in much the same way as radiation does, it is reasonable to find that when cytostatic agents are administered along with radiation the effects of these combined treatments are so poorly sustained. Combined therapy with x radiation and cytostatic agents will not be satisfactory until materials that have a very high tumor specificity and have mechanisms of action greatly different from x ray are found. Cytostatic agents known at present do not satisfy this requirement. (BBB)

29549 ON THE LOCALIZATION OF THE PLACENTA IN PLACENTA PREVIA BY MEANS OF ISOTOPES. B. S. ten Berge (Univ. of Groningen, Netherlands). Zentr. Gynaekol., 83: 1010-12(June 24, 1961). (In German)

The use of radioisotopes to determine the position of the placenta in late pregnancy is discussed, with emphasis on the radiation doses involved and the possible hazards to the fetus and mother. (BBB)

29550 RONTGENDIAGNOSTIK UND RONTGENTHERAPIE DER ERKRANKUNGEN DES ENDOKRINEN SYSTEMS. (Roentgen Diagnosis and Roentgen Therapy of Diseases of the Endocrine System). I. Ispas and T. Roxin. Jena, Ger., VEB Gustav Fischer Verlag, 1963. 275p. DM 40.40.

X-ray diagnosis and differential diagnosis of diseases of the endocrine system are described for the individual organs—pituitary body, epiphysis, thyroid gland, thymus, parathyroid gland, adrenal gland, pancreas, and gonads. The anatomy, physiology, and pathophysiology of each organ are reviewed. The x-ray therapy of diseases of the endocrine system including benign and malignant tumors is examined. The radiosensitivity of the organs is discussed. The application and dosimetry of x rays or radioisotopes are also considered. Indications and counter-indications are described. Dangers and possible incidents in the applications of radiotherapy are indicated. (J.S.R.)

29551 THE GENETICALLY SIGNIFICANT RADIATION DOSE FROM DIAGNOSTIC X-RAYS IN CANADIAN PUBLIC HOSPITALS. P. M. Baker. Report No. RPD-31. Ottawa, Department of National Health and Welfare, 1963. 95p.

A survey was made based on the thesis that the deleterious effects inflicted upon genetic material by the use of diagnostic x rays is essentially dependent upon a combination of three factors: number of persons receiving x-ray examinations; child expectancies of persons examined; and magnitude of the doses received. Data were collected at two hospitals in 1957-8 covering 15,586 x-ray examinations and these three factors were investigated both separately and combined. The results indicated that the radiation exposure to the population from this source is low in comparison to natural or background radiation, it being about one-quarter of that quantity. The average annual gonadal radiation dose by age, class, and part examined due to diagnostic x rays was calculated and the results are presented in tables. Basing calculations upon a natural radiation dose estimate of 100 mrem/yr, comparisons are made of the accumulated male and female doses due to natural radiation and diagnostic x rays. Using the assumptions that genetic damage is proportional to both dose in rems and future child expectancy, attempts were made to indicate the relative danger of genetic damage due to x-ray examinations by age class and site examined. Tables showing the product of child expectancy for sites, examined by male and female age class, give values which are directly proportional to the damage which may be expected to result from the examinations. (BBB)

29552 BASIC PHYSICS AND PRINCIPLES OF DIAGNOSTIC RADIOLOGY. David N. Cheris and Barbara H. Cheris. Chicago, Year Book Medical Publishers, 1964. 122p. $2.50.

This is a teaching manual for use with programmed instructions for a medical school course in radiology. (BBB)

29553 LES BASES PHYSIQUES DE LA RADIOTHERAPIE ET DE LA RADIOBIOLOGIE. (The Physical Bases of Radiotherapy and Radiobiology). M. Tubiana, J. Dutreix, A. Dutreix, and P. Jockey. Paris, Masson and Cie, 1963. 812p. 140F.

This is a monograph dealing with fundamental principles of radiation medicine and radiobiology. (BBB)

CHEMISTRY

General

29554 (AD-428142) QUARTERLY PROGRESS REPORT NO. 1 [ON PREPARATION OF OF, O_2F, AND O_3F RADICALS], OCTOBER 1–DECEMBER 31, 1963. A. D. Kirshenbaum and A. V. Grosse (Temple Univ., Philadelphia. Research Inst.). Contract AF04(611)-9555. 14p.

The existence of OF radicals was not proved. Since certain elusive OF-containing compounds would be strong oxidizers, identification and study of these radicals should assist in the synthesis of new oxidizers. The purpose is to produce, isolate, and identify the OF, O_2F, and O_3F radicals. It is planned to prepare these radicals by two methods: bombardment of OF_2, O_2F_2, O_3F_2, and O_2BF_4 with H atoms at 77°K or lower; and irradiation of these compounds with ^{60}Co gamma-rays at 77°K, or lower. (auth)

Analytical Procedures

29555 (AFCRL-63-575) PROMPT ACTIVATION ANALYSIS FOR BORON AND LITHIUM (thesis). Scientific Report No. 2. Lincoln Clark, Jr. and Norman C. Rasmussen (Massachusetts Inst. of Tech., Cambridge). Oct. 1963. Contract AF19(604)-7492. 92p. (AD-428201; MITNE-42)

Submitted by Lincoln Clark, Jr.

Activation analysis for boron and lithium is not possible in the usual sense because neither one becomes radioactive under neutron irradiation. However, both have large thermal neutron cross sections and activation analysis is possible if one measures the prompt particles emitted. Based on an analysis of the several types and sources of radiation which would be experienced, including background, a gas-flow proportional counter was used. The device was calibrated by use of aluminum standards containing known amounts of boron or lithium. The difference in the energy spectra makes it possible to determine the relative amounts of these two elements and, in conjunction with the count rate, to find the concentration of each in aluminum. Approximate analyses of aluminum and graphite unknowns were made in the region of one part per million boron plus lithium. An analysis of background effects indicates that the method should be applicable at concentrations which are at least a factor of ten or one hundred lower. (auth)

29556 (EUR-1601.e) ACTIVATION ANALYSIS TECHNIQUES AT THE JOINT RESEARCH LABORATORIES AT ISPRA. (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy). 1964. 78p.

The Activation Analysis Laboratory at the Joint Research Center of Ispra, together with the research works in the field of activation analysis, is routinely analyzing numerous elements as required by Euratom research on nuclear technology, biology, solid state physics, etc. After a description of the principles of the method, the techniques and the equipment employed by the laboratory are described; the possibilities of activation analysis for all the elements are then discussed. Detection limits, interferences, time required, and other information on the present working conditions are given. (auth)

29557 (KR-83) RADIOCHEMICAL SEPARATION METHODS FOR Np^{239} AND Mo^{99} USED FOR THE DETERMINATION OF MICROSCOPIC REACTOR LATTICE PARAMETERS. D. C. Perricos and J. A. Thomassen (Norway. Institutt for Atomenergi, Kjeller). Apr. 1964. 34p. (NORA-16)

The technique of reversed-phase partition chromatography was applied for the separation of ^{99}Mo and carrier-free ^{239}Np from uranium and fission products solutions. The methods were developed in order to assist in the measurement of some reactor lattice parameters. Conditions for the separations were studied and the detailed procedures are described. (auth)

29558 (LA-3088) THE GRAVIMETRIC DETERMINATION OF NICKEL IN URANIUM–NICKEL ALLOYS WITH DIMETHYLGLYOXIME. William H. Ashley, Ross D. Gardner, Robert L. Carpenter (Los Alamos Scientific Lab., N. Mex.). Apr. 1964. Contract W-7405-eng-36. 9p.

The gravimetric dimethylglyoxime method for the determination of nickel in uranium–nickel alloys has been applied and critically evaluated over a wide concentration range. In this method the nickel is precipitated from a solution containing ammonium hydroxide and citric acid, after which the precipitate is dried for 1 hour at 115°C and weighed as nickel dimethylglyoximate. It was established experimentally that the method gave excellent results when applied to alloys containing from 0.3 to 5.0 percent nickel. Fifty-two determinations on known solutions simulating uranium–nickel alloys in the above range showed an average recovery of 100.2 percent with a standard deviation of 0.5 percent relative for a single value. (auth)

29559 (NBL-210) SEMIANNUAL PROGRESS REPORT FOR THE PERIOD JULY 1963 THROUGH DECEMBER 1963. (New Brunswick Lab., AEC, N. J.). June 1964. 51p.

Abstracts are presented for seven of the ten papers; the other three papers are included in this abstract. A method involving pyrohydrolysis developed for the recovery of boron-10 from various boron-10 scrap materials is described. The final product is potassium fluoborate of at least 98% purity. A mass spectrometric procedure using a triple filament, thermal emission ion source for the analysis of lithium was developed. A method for the emission spectrographic estimation of americium in plutonium was improved and can now be used for quantitative americium determination. The sensitivity of the method is about 0.03 μg americium. The relative standard deviation for samples in the 10 to 500 ppm range is less than 6% using a europium internal standard. (N.W.R.)

For abstracts of individual papers see: 29560, 29561, 29562, 29563, 29564, 29927, and 30173.

29560 (NBL-210(p.3-4)) A SUMMARY OF TWO NEW METHODS FOR ASSAYING ELEMENTAL BORON. A. R. Eberle, L. J. Pinto, and M. W. Lerner (New Brunswick Lab., AEC, N. J.).

A summary is given of two methods for assaying elemental boron. One method involves a persulfate fusion, the other, pyrohydrolysis. (auth)

29561 (NBL-210(p.5-6)) CONVERSION OF POTASSIUM FLUOBORATE TO BORIC ACID OR SODIUM TETRA-

BORATE. A. R. Eberle and M. W. Lerner (New Brunswick Lab., AEC, N. J.).

The analysis of potassium fluoborate for boron isotopic ratio and for total boron necessitates the complete conversion of the sample to sodium borate with removal of the fluoride. This conversion is carried out by dissolving the sample in a zirconium sulfate solution and distilling methyl borate. The ester is hydrolyzed with sodium hydroxide. The further treatment of the sodium borate is described. (auth)

29562 (NBL-210(p.21-8)) THE SPECTROCHEMICAL ANALYSIS OF IMPURITIES IN BORON METAL. H. G. Yuster and H. R. Mullin (New Brunswick Lab., AEC, N. J.).

A concentration method for the spectrochemical determination of oxide matrix are evaluated with synthetic standards and when concentrations are beyond the range of these standards a dilution technique is recommended. (auth)

29563 (NBL-210(p.29-33)) MOLYBDENUM AND TECHNETIUM IN HYDROLYZED URANIUM HEXAFLUORIDE. Mary R. Clickner (New Brunswick Lab., AEC, N. J.).

A colorimetric method is described for the simultaneous determination of molybdenum and technetium in uranium hexafluoride. Absorbance measurements are made at 470 and 585 mμ. Technetium shows absorption at both wavelengths, whereas molybdenum absorbs at only 470 mμ. The molybdenum is corrected for the interference caused by technetium measured at 470 mμ. (auth)

29564 (NBL-210(p.41-7)) THE DETERMINATION OF IMPURITIES IN BORON BY X-RAY FLUORESCENCE. A. J. Busch and C. G. Goldbeck (New Brunswick Lab., AEC, N. J.).

A rapid instrumental x-ray method is described for the determination of ten impurities in a boron matrix. Calibration curves are given for the determination of each impurity. (auth)

29565 (NLCO-904) ISOTOPIC ANALYSIS OF URANIUM AS PERFORMED AT THE NATIONAL LEAD COMPANY OF OHIO. R. D. Ohlinger (National Lead Co. of Ohio, Cincinnati). [Mar. 20, 1964]. Contract [AT(30-1)-1156]. 12p. (CONF-563-1)

From the Society of Applied Spectroscopy, Cincinnati, Mar. 1964.

All uranium isotopic analyses are performed using gas-type mass spectrometers. The conversion of the samples to the hexafluoride is discussed, and the equipment and procedures used in the fluorination are described. Routine assays are made with the double-standard interpolative method. The spectrometer and analytical precision values are given. (D.L.C.)

29566 (NP-14096(p.17-22)) ACTIVATION ANALYSIS OF AEROSOLS. C. M. Gordon and R. E. Larson (Naval Research Lab., Washington, D. C.).

The use of filterable aerosols as atmospheric tracers is discussed. The technique consists of dispersing the aerosol in the air mass to be investigated, re-collection on filters, and neutron activation analysis of the tracer substances. The background radiation from elements normally present in the filter and in the atmospheric aerosol collected was investigated; the experimental techniques and results are discussed. The gamma spectra from ^{56}Mn, ^{24}Na, and ^{82}Br were measured to determine the amounts of the corresponding elements present and their effects on the use of gold, iridium, or copper as atmospheric aerosols. (R.E.U.)

29567 (TID-20640) ANALISIS QUIMICO DE SUELOS—METODOS DE LABORATORIO PARA DIAGNOSIS DE FERTILIDAD. SEGUNDA EDICION. (Chemical Analysis of Soil— Laboratory Methods for the Study of Fertility. Second Edition). J. F. Saiz del Rio and E. Bornemisza S. (Inter-American Inst. of Agricultural Sciences. Turrialba, Costa Rica). 1962. 109p.

Laboratory methods are given for the determination of the acidity, exchange capacity, exchangeable metallic cations, nitrogen, phosphorus, potassium, micronutrients, soluble salts, and organic matter of soils. Methods of soil sampling are described in the introduction. (J.S.R.)

29568 (EURAEC-1014) ANALYSIS AND CONSTITUTION OF THE 1ST U–Pu SET (0.043% OF Pu). Special Report No. 17. SEC Report No. 135. J. P. Brunet, D. de Lapparent, and P. Lourme (France. Commissariat à l'Énergie Atomique, Paris). Nov. 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract 3742. 64p. (A translation)

Apparatus, methods, and results are given for determining the plutonium content in a natural U–Pu alloy by neutron detection and measurement. A sample of known content (0.043% Pu) was used to test the procedure. The counting method is described. (R.E.U.)

29569 SPECTROGRAPHIC DETERMINATION OF BERYLLIUM IN AIR, BIOLOGICAL MATERIALS, AND ORES USING THE SUSTAINING A.C. ARC. Robert G. Keenan and John L. Holtz (Public Health Service, Cincinnati). Am. Ind. Hyg. Assoc. J., 25: 254-63(May-June 1964).

A spectrographic method was developed, using a sustaining a-c arc, for the quantitative determination of Be in amounts as low as 0.001 μg. The method is based upon the excitation of Be volatilized from a chloride matrix, which is prepared from a Li chloride–graphite buffer, liver ash, and the ashed or fused sample. Experiments with ^{7}Be provided quantitative recoveries of the radioactive tracer from urine samples and from bertrandite and beryl ores. Application of the method to samples of Be ores provided, in six out of eight cases, less than 10% deviations from the results of the chemical analyses reported by the U. S. Bureau of Mines. (auth)

29570 MEASUREMENT OF Th^{232}, Th^{228} AND THEIR DAUGHTERS IN TISSUE SAMPLES OF THOROTRAST PATIENTS. F. Unnewehr, A. Kaul, and W. Stahlhofen (Max-Planck-Institut für Biophysik, Frankfurt am Main). Atomkernenergie, 9: 181-5(May-June 1964). (In German)

The ^{228}Th content of tissue samples of thorotrast patients was measured with a mixing method and by γ-ray spectrometry. In the mixing method the chemically treated tissue ashes are mixed with ZnS(Ag) as scintillator in a certain proportion. With this method both the total α activity of tissue samples and their ^{228}Th content are determined by a coincidence measurement of the disintegrations of $^{220}Rn \rightarrow {}^{216}Po \rightarrow {}^{212}Pb$ (half life of ^{216}Po = 0.16 sec). Radioactive equilibrium between ^{228}Th and its daughters is necessary. The ^{232}Th activity of different samples of autopsy and biopsy material of thorotrast patients was estimated by the difference between the measured total α counting rate and the calculated rate for ^{228}Th and its daughters. For bone and soft tissue the activity ratios $^{232}Th : {}^{228}Th$ were determined. The corresponding ratios were about 0.6 for bone and 2.5 for soft tissue, on the average. The ^{228}Th content was also measured by γ spectrometry. The results of both methods agreed within ±10%. All samples were pre-

pared for histo-autoradiographic determinations of their α activity. For calculation of the ^{228}Th content of the samples by the number of observed α tracks, knowledge of the activity ratios $^{232}Th : ^{228}Th$ was necessary. The results of the histo-autoradiographic analyses were compared with results of both the mixing method and the γ spectrometry. (auth)

29571 THE CONCENTRATIONS OF COBALT, COPPER, IRON AND ZINC IN SOME NORMAL HUMAN TISSUES AS DETERMINED BY NEUTRON-ACTIVATION ANALYSIS. R. M. Parr and D. M. Taylor (Royal Cancer Hospital, London). Biochem. J., 91: 424-31(June 1964).

A method is described for determining Co, Cu, Fe, and Zn in biological materials by neutron-activation analysis. The sensitivities attainable are 0.0002, 0.001, 0.1, and 0.01 μg respectively. The normal concentrations of Co, Cu, Fe, and Zn were determined in liver, spleen, and other tissues taken from healthy human subjects, both infants and adults, who were victims of sudden accidental death. The elements were also determined in normal human serum. Cobalt concentrations in adult tissues ranged from a mean value of 0.0003 μg in serum, to 0.07 μg/g wet wt of tissue in liver. The liver of newborn infants contained much lower concentrations than adults. Copper, Fe, and Zn were detected at concentrations that were in general agreement with values reported by workers using other methods of analysis. Significantly elevated concentrations of both Cu and Zn were observed in the liver of newborn infants. (auth)

29572 A RADIOMETRIC METHOD FOR ESTIMATING BLOOD CHOLINESTERASE IN THE FIELD. F. P. W. Winteringham and R. W. Disney (Pest Infestation Lab., Slough, Eng.). Bull. World Health Organ., 30: 119-25(1964).

The increasing use of anticholinesterase insecticides such as organophosphates and carbamates against agricultural pests and disease vectors has emphasized the need for effective methods of detecting exposure in man. Estimation of blood cholinesterase activity provides an index of exposure to organophosphorus compounds. Therefore, a new, radiometric method was developed which provides for the simple and rapid measurement of human blood cholinesterase under field conditions. It involves minimal dilution of samples and use of very low substrate concentrations, and is thus more sensitive to cholinesterase inhibition by reversible anticholinesterases such as carbamates than the conventional manometric or change-in-pH methods. A 20-μl sample of hemolyzed whole blood is mixed with ^{14}C-labeled acetylcholine on a cavity microscope slide. After 0.5 to 3 min the mixture is acidified and dried. Under these conditions radioactive acetate liberated enzymatically is completely volatile while the radioactive unhydrolyzed substrate is not. The loss of radioactivity on acidification and drying is therefore a direct maesure of the acetylcholinesterase activity. The levels of radioactivity employed are far below those likely to present any significant health hazard or to require special lab conditions. Although the method requires a labeled substrate, a single preparation is sufficient for several hundred thousand enzyme assays. (BBB)

29573 SPECTROPHOTOMETRIC DETERMINATION OF BERYLLIUM IN MAGNESIUM–ALUMINUM ALLOYS. Emiko Sudo and Haruno Ogawa (National Research Inst. for Metals, Tokyo). Bunseki Kagaku, 13: 406-12(May 1964). (In Japanese)

Determination of above 0.0001% beryllium in magnesium–aluminum alloys was investigated. To an aliquot of 100 mg of sample, 2.5 ml of ethylenediamine tetraacetic acid (5%) was added and then the pH was adjusted to 3.5 ± 0.2 with hydrochloric acid and sodium hydroxide. In order to remove aluminum, the solution was passed through a cation exchange resin column. The column was washed with the solution of pH 4, and beryllium was eluted with 1M nitric acid. The effluent was evaporated nearly to dryness and the residue was dissolved in water. Then 20 ml of ethylenediamine tetraacetic acid (10%) and 1 ml of aqueous acetylacetone (5%) were added and the pH was adjusted to 7.0 to 8.0. Beryllium complex was extracted with 10 ml of chloroform. The organic phase was backwashed twice with 50 ml of 0.1N sodium hydroxide. The absorbance was measured at 295 mμ by comparison with chloroform. In case of samples containing above 0.001% beryllium, analysis could be carried out as follows without an ion exchange treatment. To an aliquot of 20 mg of sample, 10 ml of ethylenediamine tetraacetic acid (10%) is added and the pH is adjusted to 6.0 ± 0.1. In 10 minutes after adding 1 ml of aqueous acetylacetone (5%), beryllium is extracted with 10 ml of chloroform. The organic phase is treated as above. (auth)

29574 SPECTROPHOTOMETRIC DETERMINATION OF STRONTIUM IN SEA WATER USING O-CRESOLPHTHALEIN COMPLEXONE. Katsuya Uesugi (Himeji Inst. of Tech., Japan), Masayuki Tabushi, Toshiharu Murakami, and Tsunenobu Shigematsu. Bunseki Kagaku, 13: 440-4(May 1964). (In Japanese)

A spectrophotometric method for strontium using o-cresolphthalein complexone was studied and applied to the determination of strontium in sea water and brine samples. Strontium reacted with the reagent at pH 11 to 12 to form a colored complex having an absorption maximum at 575 mμ. Beer's law was followed up to 3 ppm of strontium and the molar extinction coefficient was 32,000. In order to prevent the interfering effects of diverse ions, strontium was separated by coprecipitation with calcium oxalate and by cation exchange treatment, whereby 96 to 97% recovery of strontium was ascertained by using ^{89}Sr as a tracer. Strontium in sea water samples was estimated to be 7 to 8 mg/l, and in brine samples to be 30 mg/l. (auth)

29575 ANALYSIS OF INORGANIC GASES USING GAS-CHROMATOGRAPHY WITH A RADIOACTIVE IONIZATION DETECTOR. Tsugio Takeuchi, Iwao Fujishima, and Shin Tsuge (Nagoya Univ., Japan). Bunseki Kagaku, 13: 449-56 (May 1964). (In Japanese)

Inorganic gases were determined after they were separated by a molecular sieve 5-A packed column, using a radioactive ionization detector with a 100-μC ^{210}Pb α source. A d-c voltage stabilizer, an impedance conversion circuit, and a low pressure gas dilution apparatus, which enable an accurate sampling of gases from 0.01 μl to 10 ml are described. The detector response vs. applied voltage and the effect of flow rate on 4 kinds of carrier gases such as hydrogen, helium, argon, and argon containing the vapor of 1,2,4,5-tetrachlorobenzene were examined and the results are discussed. Under optimum experimental conditions including flow rate, kind of carrier gases, input resistance of the impedance conversion circuit, applied voltage on the detector, sample size, operating temperature, etc., 4.5×10^{-10} to 5×10^{-4} mol of oxygen and 2.7×10^{-9} to 5×10^{-4} mol of nitrogen were estimable. Optimum conditions for the detector response against the flow rate of each carrier gases are given. (auth)

29576 THE DETERMINATION OF GOLD IN QUARTZ VIA ACTIVATION ANALYSIS. Miloslav Vobecky and Oldrich Knotek (Inst. for Nuclear Research, Czechoslovak

Academy of Sciences, Rez). Chem. Listy, 58: 15-25(1964). (In Czech.)

A method for the determination of gold in quartz with the help of neutron activation analysis is described. The gold was isolated from the irradiated sample by extraction. The quantitative evaluation was carried out by comparison of the intensities of the characteristic lines in the gamma spectrum of the samples and of a standard. Under the given radiation conditions (1.5×10^{12} neutrons · cm^{-2} · sec^{-1}) 10^{-10} g of gold could be determined. (tr-auth)

29577 ACTIVATION ANALYSIS APPLIED TO NUCLEAR MATERIALS. J. Laverlochere (Centre d'Etudes Nucleaires, Grenoble, France). Chim. Anal. (Paris), 46: 23-30(Jan. 1964). (In French)

The activation method for the analysis of nuclear materials is described with a consideration of the principle, calibration, nuclear reactions used, precision and causes of error, and advantages of the method. Its application to the analysis of U, Be, Th, Zr, Hf, Ti, Nb, Al, steel, graphite, Na, Mg, and organic liquids is discussed. (J.S.R.)

29578 RADIOMETRIC EQUIPMENT USED TO DETERMINE URANIUM-, THORIUM- AND RADIUM-CONTENTS OF STONES. Dezso Kiss, Lajos Matus, and Zoltan Zamori (Central Research Inst. of Physics, Budapest). Energia Atomtech., 15: 368-74(Aug. 1962). (In Hungarian)

29579 THE APPLICATION OF NUCLEAR TECHNIQUES IN COAL ANALYSIS. T. C. Martin, S. C. Mathur, and I. L. Morgan (Texas Nuclear Corp., Austin). Intern. J. Appl. Radiation Isotopes, 15: 331-8(June 1964).

Results of a feasibility study on utilizing nuclear techniques in coal analysis showed that the carbon, oxygen, aluminum, and silicon content of coal can be fairly accurately determined. The accuracy with which these four elements can be measured is in the range of from 1 to 3% under laboratory conditions. These results also indicated that it is not possible to measure the other minor elements present in coal to the same degree of precision. The nuclear techniques used in this study are fast-neutron inelastic scattering and fast-neutron activation analysis. The analysis of coal depends on the use of empirical relationships connecting the element or elements measured with the required parameter. (auth)

29580 THE MEASUREMENT OF AQUEOUS SOLUTIONS OF METALLIC RADIOISOTOPES BY LIQUID SCINTILLATION METHODS. A. Dyer, J. M. Fawcett, and D. U. Potts (Royal Coll. of Advanced Tech., Salford, Lancs., Eng.). Intern. J. Appl. Radiation Isotopes, 15: 377-80(June 1964).

Determination of ^{110m}Ag, ^{22}Na, ^{147}Pm, and ^{204}Tl in aqueous solutions by scintillation methods is described. (M.C.G.)

29581 RAPID DETERMINATION OF YTTRIUM IN AQUEOUS SOLUTIONS CONTAINING DYSPROSIUM AND IN ORE SAMPLES BY NEUTRON ACTIVATION. M. Okada (Government Chemical Industrial Research Inst., Tokyo) and Y. Kamemoto. Intern. J. Appl. Radiation Isotopes, 15: 381-2(June 1964).

A neutron flux of 3×10^{11} $n/cm^2/sec$ was used for determination of yttrium in aqueous solutions containing dysprosium and in ore samples by activation of 16-sec ^{89m}Y. (M.C.G.)

29582 A NEW ANALYTICAL DETERMINATION METHOD FOR THE URANYL ION AS AMMONIUM SALT OF AURINTRICARBOXYLIC ACID AND ITS SEPARATION FROM SOME OTHER METAL IONS. F. Baykut, T. Halicioğlu, E. Oezcan, and O. Tarhan (Universität, Istanbul). Istanbul Univ. Fen Fak. Mecmuasi, Seri C, 28: 123-9 (July-Oct. 1963). (In German)

Uranyl ions, which formed a colored chelate with the ammonium salt of aurintricarboxylic acid, were quantitatively determined. In the presence of Cu^{2+}, Zn^{2+}, Co^{2+}, Cd^{2+}, Pb^{2+}, and Ag^{+} ions, the determination of uranyl ions by this method was found to be possible, since these cations form chelates with dithizone and can thus be removed, while the uranyl cation does not form a chelate with dithizone. (tr-auth)

29583 FERTILIZER ANALYSIS: DETERMINATION OF POTASSIUM IN SOLIDS AND LIQUIDS BY MEASUREMENT OF THE GAMMA ACTIVITY OF NATURALLY RADIOACTIVE POTASSIUM-40. Wayne G. Harris, Wayne V. Kessler, John E. Christian, and Elwyn D. Schall (Purdue Univ., Lafayette, Ind.). J. Agr. Food Chem., 12: 144-6(Mar-Apr. 1964).

A method is described for the analysis of K in pure K salts and liquid fertilizers based on its γ activity. Solid and liquid standards containing different concentrations of K were prepared, and their γ activities were measured. Regression equations relating the activities to K concentrations were calculated. The γ activities of pure K compounds were measured by liquid scintillation, and their K contents determined by means of the regression equations. The measured K contents were compared with the actual K contents calculated from molecular formulas. Similarly, the potassium oxide contents of liquid fertilizers were measured and compared to those determined by chemical analysis. The method is applicable to the routine analysis of samples with 5% or greater K contents, provided the samples have no radioactive contamination. The uranium contaminantion limitation may be overcome by applying a correction based on the phosphate content. (BBB)

29584 DETERMINATION OF STRONTIUM-90 IN FOODS BY THE Di(2-ETHYLHEXYL) PHOSPHORIC ACID (HDEHP) METHOD. Sidney Davis and Alphonso Arnold (Food and Drug Administration, Washington, D.C.). J. Assoc. Offic. Agr. Chemists, 47: 580-6(June 1964).

A method was developed for routine surveillance of ^{90}Si in foods in which HDEHP extraction is used to separate ^{90}Y from the ^{90}Sr. The counting technique is the same as that in the Harley method. Yttrium carrier is added to correct for losses, to make the method suitable for routine analysis. Average recovery from spiked pre-1945 food ash was 100.4%. There was no statistical difference in effectiveness of extraction between pH 1.1 and 1.5. ^{90}Sr was quantitatively separated from ^{90}Y. The proposed HDEHP method was compared with the Harley method. It was found to be an adequate substitute for surveillance studies, and saved considerable time. (auth)

29585 VOLTAMMETRY OF NICKEL IN MOLTEN LITHIUM FLUORIDE–SODIUM FLUORIDE–POTASSIUM FLUORIDE. D. L. Manning (Oak Ridge National Lab., Tenn.). J. Electroanal. Chem., 7: 302-6(Apr. 1964).

Results are presented on the rapid scan voltammetry and anodic stripping voltammetry of nickel in molten LiF–NaF–KF. The technique of anodic stripping voltammetry was found to be promising as a means of determining trace quantities of nickel directly in the melt; as little as I ppm could be detected. The half-wave potential for the reduction of Ni(II → Ni(o) occurred at approximately –0.2 v vs the platinum quasi-reference electrode. Current–voltage curves were recorded at a pyrolytic graphite indicator electrode at voltage scan rates from 50 mv/min to 10 v/min. At the faster scan rates, peak-shaped curves resulted, which indicated that the transport process was

mainly diffusion-controlled. A diffusion coefficient of $\sim 1 \times 10^{-6}$ cm^2/sec at 500° was calculated. An activation energy of about 18 kcal/mole was calculated for the current-limiting process, which corresponds to the reduction of Ni(II) to the metal. (auth)

29586 BREMSSTRAHLUNG FLUORESCENCE ANALYSIS. W. Kuehn (Isotopen-Studiengesellschaft e.V., Frankfurt am Main). Kerntechnik, 6: 239-44(June 1964). (In German)

Commercial x-ray fluorescence spectrographs work with x-ray tubes and crystal monochromators. Measuring processes are discussed in connection with industrial use of radionuclide, which use instead of the x-ray tube a suitable β-emitter and as spectroscopical element electronical analysis. Equipment is described with which elements between 1 to 10-kev are examined as to quality and quantity. (auth)

29587 MEASUREMENT OF THE SPECIFIC GAMMA-ACTIVITY OF WATER AS A FUNCTION OF QUANTUM ENERGY AND MEASURING VOLUME. H. Dresia and W. Burg (Staatliche Ingenieurschule für Maschinenwesen, Essen). Kerntechnik, 6: 254-6(June 1964).

A counting gage with a NaI scintillation counter is described, which permits measurement of the specific gamma activity of water almost independent of the energy of the gamma quanta. Up to 20% deviations occurred when the diameter of the cylindrical tank was at least 40 cm. Calibration measurements were carried out with ^{40}K, ^{137}Cs/^{137}Ba. The results were in good agreement with calculations, in which the cylindrical counting geometry was approximated by a spherical geometry. (auth)

29588 PAPER AND THIN-LAYER CHROMATOGRAPHY OF RADIOACTIVELY LABELLED COMPOUNDS. Kerntechnik, 6: 268-9(June 1964). (In German)

Advantages of paper and thin-layer chromatography for identification of radioactively labeled compounds are discussed. The methods and their efficiency are described. (M.C.G.)

29589 β-RADIATION REFLECTION BY ELECTROLYTIC SOLUTIONS. Attila Vértes, Éva Fodor, and Andras Karafiáth. Magy. Kem. Folyoirat, 69: 195-7(May 1963). (In Hungarian)

Beta-particle reflection by aqueous solutions of KCl, NaCl, KBr, and KI were measured as a function of weight percent. On the basis of these measurements, it was assumed that the beta reflection of electrolytic solutions, in addition to the "average order number" of the solution, is also dependent on its density. (tr-auth)

29590 PORTABLE NEUTRON GENERATOR FOR ACTIVATION ANALYSIS. Endre Pásztor and Ervin Klopfer. Magy Tud. Akad. Kozp. Fiz. Kut. Int. Kozlemen., 12: 143-9 (1964). (In Hungarian).

A small, compact neutron generator built for activation analysis is described. The apparatus is composed of two main parts: a high voltage supply and an accelerator. The accelerating voltage is 120 kv, and the accelerated ion current is 1 ma. The maximum neutron yield obtained is $1 \simeq 5 \times 10^{10}$ n/sec. (auth)

29591 STUDY ON THE DETERMINATION OF TRACES OF IMPURITIES IN URANIUM METAL AS NUCLEAR FUEL. Tsugio Takeuchi, Masami Suzuki, Daido Ishii, Ken Saito, Iwao Fujishima, Tsutomu Fukasawa, Tamotsu Tanaka, and Takayoshi Yoshimori. Mem. Fac. Eng., Nagoya Univ., 15: 1-51(May 1963).

Analytical procedures and results for the determination of traces of impurities in uranium metal are summarized. Spectrophotometric procedures are given for As, B, Cd, Co, Cu, Fe, Rb, Mn, Mo, Ni, N, P, Si, Ag, Tb, and Zr. Polarographic methods are given for Cd; Cl; Pb; simultaneous determination of Cu, Pb, Cd, Ni, and Co; and simultaneous determination of Cd, Co, Cu, Fe, Mn, Ni, Pb, and Zn. Coulometric methods are described for V and Ag. X-ray spectrometric methods for Th and spectrographic methods for Ni, Al, Cr, Mn, Ca, Cu, C, and rare earths are described. (M.C.G.)

29592 ON THE DETECTION OF URANIUM IN A WEISZ RING OVEN. L. Hainberger S. J. and G. Zundel (Universidade Católica, Rio de Janeiro). Mikrochim. Ichoanal. Acta, No. 2-4 175-8(1964).

A rapid and sensitive test for uranium is described. The uranium is separated from interfering elements in a Weisz ring oven and fused into a sodium fluoride bead. The presence of uranium can be detected from the fluorescence of the bead. The method can also be used for the analysis of minerals. (auth)

29593 A DEVICE FOR THE SEQUENTIAL SAMPLING OF THE EFFLUENTS FROM A GROUP OF ION-EXCHANGE COLUMNS. D. B. Hawkins and Mack Wilhelmsen (Atomic Energy Commission, Idaho Falls, Idaho). Nature, 202: 1194-6(June 20, 1964).

An evaluation of the ion-exchange properties of the soil for certain hazardous radioisotopes is necessary for the safe discharge of radioactive liquid wastes to the soil. This evaluation was carried out by packing the soil in ion-exchange columns, passing a solution containing the radioisotopes of interest through the soil, and analyzing the effluent liquid for these isotopes. A number of individual column experiments must be performed to investigate the behavior of the radioisotopes as a function of pH, chemical composition, rate of flow, and other factors. Swivel-funnels were developed for use in conjunction with a fraction collector in the operation of several columns simultaneously. A diagrammatic sketch and wiring diagram for the device are included. (C.H.)

29594 ELECTRODEPOSITION OF SULPHUR-35 BY MEANS OF CO-DEPOSITION FROM ORGANIC PLATING SOLUTIONS. W. Parker (Chalmers Univ. of Tech., Gothenburg, Sweden), H. Fischer-Colbrie, and H. Regal. Nature, 202: 1203-4(June 20, 1964).

A procedure is described for the electrodeposition of thin layers of ^{35}S from alcohol solutions on Mn plates. Possible applications of the plates suggested include pure β-counting samples, sources for β-radiography, and as medical applications. (C.H.)

29595 THE ANALOX—AN INDUSTRIAL APPLICATION OF ACTIVATION ANALYSIS. A. L. Gray (Plessey Nucleonics Ltd., Northampton, Eng.). Nucl. Eng., 9: 205-7(June 1964).

A neutron generator with a yield of more than 10^9 n/sec was used in Analox equipment designed for activation analysis to determine the amount of oxygen in steel prepared by the oxygen process. In the neutron generator a beam of deuterons is allowed to strike a tritium target to produce the neutrons. The neutron generator is combined with a sample transport mechanism and counting and control equipment in the Analox. The operating sequence, performance, and safety of the equipment is described. (M.C.G.)

29596 TECHNIQUE OF ANALYSIS OF THE PHYSICO-CHEMICAL STATE OF RADIOACTIVE ELEMENTS BY PAPER ELECTROPHORESIS COMBINED WITH RECORD-

ING OF THE ACTIVITY. J. Lafuma, Ch. Sachs, and J.-L. Funck-Brentano (CEN, Fontenay-aux-Roses, France). Rev. Franc. Etudes Clin. Biol., 8: 700-6(1963).

A technique is described that combines paper electrophoresis and radioactivity recording for the identification of the physico-chemical state of one or several radioelements in a liquid medium. The ease and rapidity of the technique are emphasized. (Excerpta Med., Sect. XXIII, 1: No. 2, (Feb. 1964)).

29597 X-RAY FLUORESCENCE ANALYSIS FROM A RADIOACTIVE SOURCE; APPLICATION TO THE RAPID ANALYSIS OF LORRAINE IRON ORE. G. Seibel and J. Y. Le Traon. Rev. Met. (Paris), 61: 333-53(Apr. 1964). (In French)

The equipment used for x-ray fluorescence analysis of Lorraine iron ore has a radioactive, tritium source absorbed by titanium, a sealed x-ray proportional counter and an electron spectrometer with two channels for the simultaneous measurement of the characteristic x-ray intensities of iron and calcium. This method of analysis is suitable for the determination of iron and lime in ores, agglomerates, and slags. (auth)

29598 DETERMINATION OF GOLD IN SERUM AND URINE BY NEUTRON ACTIVATION ANALYSIS. S. Solvsten (Rigshospitalet, Copenhagen). Scan. J. Clin. Lab. Invest., 16: 39-44(1964).

A method for determining the Au distribution in biological material using neutron irradiation, radiochemical separation of the activated Au, and gamma spectrometric determination of the activity is described. The method permits the determination of 10^{-9} g Au in 50 µl of urine or plasma with an accuracy of ±2%. The method may be used for examination of Au concentrations in plasma, and for determinations of the excretion of Au in urine and feces in patients, with rheumatoid arthritis treated with colloidal Au. This method permits simultaneous irradiation of 100 to 150 samples which can be counted within 48 hr after irradiation. The samples were activated by neutron irradiation in a U reactor (DR 2, Danish Atomic Energy Commission Research Establishment, Riso) for 2 hr by a neutron flux of 75 to 80 × 10^{11} neutrons/cm^2/sec (thermal neutrons). Samples were counted in a 3 × 3 in. NaI(Tl) well-crystal connected with an automatic sample-changer. The pulses from the scintillation detector were analyzed by a γ-spectrometer with scaler. In the absence of shielding, the radiation dose rate for 150 plasma samples, determined immediately upon termination of activation, ranged from 25 to 50 mr/hr, measured at a distance of 1 m. (BBB)

29599 THE USE OF LIQUID SCINTILLATION FOR THE ASSAY OF CARBON-14 IN CLAY AND SOIL SUSPENSIONS. A. L. Page, James R. Sims, and F. T. Bingham (Univ. of California, Citrus Research Center, Riverside and Agricultural Experiment Station, Riverside, Calif.). Soil Sci. Soc. Am. Proc., 28: 359-63(May-June 1964).

The use of liquid scintillation for the assay of ^{14}C in layer silicate and soil suspensions is evaluated by various procedures with several scintillator media. The effects of sample weight, color, settling time, and the level of activity on the counting characteristics of scintillator media which contain soils and layer silicates are presented. Highly statistically significant linear regressions, which differed for each solid tested, were obtained between the level of activity added and the observed activity. The differences between the materials tested were related predominantly to the color which the solid imparted to the scintillator medium. A procedure for the determination of the retention of carbon compounds by layer silicates and soils is presented. The procedure described is specific, but can easily be modified to fit the needs of related studies. (auth)

29600 PAPER CHROMATOGRAPHY IN INORGANIC QUALITATIVE ANALYSIS. A. Schneer-Erdey and T. Tóth (Research Group for Inorganic Chemistry, Budapest). Talanta, 11: 907-11(June 1964).

A two-dimensional paper chromatographic method for the separation and identification of several metal ions is described. After preparation, the sample is run with an ethanol : hydrochloric acid : water (75 : 20 : 5) mixture, and later in a second dimension with a tetrahydrofuran : nitric acid : water (85 : 5 : 10) mixture. The chromatogram can be developed with a 0.2% ethanolic solution of Morin, and examined both in sunlight and in ultraviolet light, in acidic conditions and after alkalization with ammonia vapor. Those metal ions, which migrate together in the first solvent, are separated in the second one, and can be identified reliably. The composition of the original sample can be deduced from the R_f values, colors, and fluorescences of the various spots. (auth)

29601 MICROTITRATION OF PLUTONIUM(III) AND HYDROGEN PEROXIDE PRESENT WITH PLUTONIUM(IV) IN HYDROCHLORIC ACID SOLUTIONS. P. V. Balakrishnan, A. S. Ghosh Mazumdar, and R. N. Singh (Atomic Energy Establishment, Trombay, India). Talanta, 11: 977-9 (June 1964).

A method was developed for the estimation of a few tens of micrograms of Pu(III) and hydrogen peroxide in hydrochloric acid solutions containing Pu(IV). The sum of Pu(III) and hydrogen peroxide was obtained by successive addition, in excess, of known quantities of potassium dichromate and Fe(II) sulfate to one aliquot of the mixture, then titrating with Ce(IV) sulfate using ferroin as indicator. Their difference was obtained by adding the same quantities of the first two reagents in reverse order to another aliquot, then completing the titration as before. (auth)

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Refer also to abstracts 29960 and 30856.

29602 (LADC-6087) PREPARATION AND CRYSTAL DATA FOR LANTHANIDE AND ACTINIDE TRI-IODIDES. L. B. Asprey, T. K. Keenan, and F. H. Kruse (Los Alamos Scientific Lab., N. Mex.). [1963]. Contract W-7405-eng-36. 13p. (CONF-405-43)

From 4th Rare Earth Research Conference, Phoenix, Ariz., Apr. 1964.

Lattice parameters and crystal structure types for twelve lanthanide tri-iodides (excepting only promethium and europium) have been determined. Similar data have been obtained for yttrium, americium, and plutonium tri-iodides. Two structure types occur in the lanthanide tri-iodides. The lighter members, LaI_3 through NdI_3, have orthorhombic symmetry ($PuBr_3$ type) while the heavier members of the series are hexagonal (BiI_3 type). An analogous transition is observed in the actinide series between PuI_3 and AmI_3, the former being orthorhombic and the latter hexagonal. Treatment of AmI_3 with hydrogen at elevated temperatures gave no evidence of a divalent compound of americium. (auth)

29603 (NP-14021) BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF GASES AND GAS-CONDENSED PHASE REACTIONS. L. Brewer, comp. (California. Univ., Berkeley). Dec. 31, 1963. 27p.

A total of 259 references is presented on spectra of interest to high-temperature chemistry and on reactions between gases and condensed phases. (D.L.C.)

29604 (NRL-6094) HIGH-TEMPERATURE PROPERTIES OF SODIUM AND POTASSIUM. Twelfth Progress Report, July 1–September 30, 1963. C. T. Ewing, J. P. Stone, J. R. Spann, E. W. Steinkuller, D. D. Williams, and R. R. Miller (Naval Research Lab., Washington, D. C.). June 9, 1964. 44p.

Thermophysical properties of potassium (saturation and superheat properties of the vapor, density, and specific heat of the liquid) are presented together with a thermodynamic treatment of the data. Two equations of state are advanced, and additional saturation and superheat properties of the vapor are derived from these equations. Engineering properties (enthalpy, entropy, specific volume, and specific heat) and compositional information (weight fraction of dimer, weight fraction of trimer, and average molecular weight) are tabulated for 800 vapor states at 1400 to 2525°F and 0.2 to 28 atm. (auth)

29605 (ORNL-TM-872) A PRELIMINARY STUDY ON URANIUM CARBIDE SYNTHESIS, USING A PLASMA JET. D. M. Helton (Oak Ridge National Lab., Tenn.). May 25, 1964. Contract W-7405-eng-26. 23p.

Significant yields of uranium carbide were not obtained in preliminary studies made in a plasma jet by the gas phase reaction of UF_6 with CH_4 and H_2. Some success with uranium carbide formation was obtained when finely divided SiC was pre-mixed with the gaseous mixture and then introduced into the plasma stream. However, these yields were never greater than 1%. Further experiments are described in which unsuccessful attempts were made toward increasing the uranium carbide yield. Thermodynamic considerations for the problem are given. (auth)

29606 (RTD-TDR-63-4110) VIBRATIONAL AND ROTATIONAL ENERGY LEVELS. (Johns Hopkins Univ., Baltimore. Carlyle Barton Lab.). Sept. 30, 1963. Contract AF33(616)-6457. 17p. (AD-428220; WR-AF-5)

Two molecular systems, each having behavior that undergoes only slight changes in certain solid-state environments, were studied. The first, a polar molecule in an inert gas crystal, is of interest because the constraints on the molecular rotation, including electronic correlation effects, are expected to be small. The second, the uranyl complex in an ionic solid, was studied because of the interactions between the lattice vibrations and the persistent uranyl vibrations. The results of these studies are given. (auth)

29607 (UCRL-7370) THE CRYSTAL STRUCTURE OF BADDELEYITE (MONOCLINIC ZrO_2) AND ITS RELATION TO THE POLYMORPHISM OF ZrO_2. Deane K. Smith and Herbert W. Newkirk (California. Univ., Livermore. Lawrence Radiation Lab.). May 24, 1963. Contract W-7405-eng-48. 32p.

The crystal structure of baddeleyite has been redetermined using new x-ray data collected from a synthetic single crystal. A three dimensional least-squares refinement reconfirms the structure determined by McCullough and Trueblood (Acta Cryst. 12: 507(1959)). The $P2_1/c$ unit cell contains 4 ZrO_2. All the atoms are in the general positions with the Zr at x = 0.2758, y = 0.0411, and z = 0.2082; O_I at x = 0.070, y = 0.342, and z = 0.341; and O_{II} at x = 0.442, y = 0.755, and z = 0.179. The Zr is in seven-fold coordination with Zr–O distances ranging from 2.05 Å to 2.28 Å. The O_I is coordinated to three Zr atoms in an approximately planar configuration. The O_{II} is four coordinated in a distorted tetrahedral configuration. The structure can be described as a distortion of the cubic fluorite (CaF_2) structure. The O_{II} atoms lie in a plane parallel to (100) and form a slightly distorted square array. The Zr atoms lying above and below the O_{II} planes are positioned alternately above or below a square of O_{II} atoms. The O_I atoms also lie in a plane parallel to (100) but are arranged irregularly so that only three are coordinated to any one Zr atom. The common polysynthetic (100) twinning is discussed in terms of the layer arrangement of atoms and a probable arrangement at the composition plane is proposed. The most likely structural rearrangements in the polymorphic inversion series monoclinic-tetragonal-cubic is also discussed in terms of the layering parallel to (100). (auth)

29608 (UCRL-11205) REDUCTION USING SOLUTIONS OF CALCIUM IN MOLTEN SALTS. H. Bloom (California. Univ., Berkeley. Lawrence Radiation Lab.). Dec. 1963. Contract W-7405-eng-48. 7p.

Hydrogen in the presence of Ca dissolved in a CaI_2–KI eutectic was used as a reducing agent with silica in an attempt to obtain silane. Hydrogen was found to react with Ca to form CaH_2 which then reacted with SiO_2 to form Si. A brownish black powder was obtained which was a mixture of Si and SiO_2, but no silane was found. (D.L.C.)

29609 (AERE-Trans-999) DESORPTION UNDER NITROGEN OR HYDROGEN OF OXYGEN CHEMISORBED ON GRAPHITE. H. Le Bail (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). Translated by R. R. Inston (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.), from report DPC/CPh/62/95. 1962. 53p.

When graphite previously oxidized in air is heated to 900°C in a slow current of nitrogen at atmospheric pressure, the main product is CO, together with a quantity of CO_2 which becomes smaller as the oxidation temperature (O.T.) is raised: for O.T. = 224°C, CO/CO_2 = 6.2; for O.T. = 660°C, CO/CO_2 = 46.4, and at the same time the total amount of desorbed oxygen varies from 1.54×10^{-6} g-atom per g graphite (O.T. = 224°) to 6.14×10^{-6} g-atom per g (O.T. = 660°). When the temperature rise in degassing is linear with time (25 to 50°C per hr), the CO and CO_2 release rates have simultaneous maxima which increase slightly with O.T. and become constant when the latter is above 400 to 500°C approximately; degassing ends at about 800°C. The presence of a little water vapor in the nitrogen (about 120×10^{-6} v/v) raises slightly the temperature of initial and maximum release of CO, in accordance with the well-known inhibiting effect of H_2O on oxidation of graphite. When N_2 is replaced by H_2 there is simultaneous formation of H_2O, CO_2, and CO. For natural graphites, $H_2O \approx CO_2 > CO$; when the degassing temperature increases linearly with time, further peaks occur, the H_2O peak being simultaneous with the CO and CO_2 peaks. For porous artificial graphites, $H_2O > CO_2 > CO$, the water becomes more predominant for good-quality industrial graphites as compared with graphites of very high purity. When the temperature increase is linear, only the peaks of CO, CO_2, and H_2O are observed for very pure graphites; the temperature of maximum desorption rates is not greater than 550°, whereas under nitrogen it is not greater than 605°C. For industrial graphites (of lower purity) the main peak of water is preceded by another peak at a distance of about 100°; the descent of this peak largely overlaps with the rise of the main peak. A third quite separate peak follows, with a maximum at about 800°C. The additional peaks are apparently due to

impurities, but it has not yet been possible to identify these. These desorptions of water under hydrogen, except perhaps that corresponding to the 800°C peak, are accompanied by chemisorption of hydrogen which is unaffected by degassing under nitrogen at 900°C; if this is followed by oxidation, water is collected in an amount equal in many experiments to that of the water released under hydrogen. This indicates that desorbed oxygen is replaced by H_2 or by 2H. The phenomena described above may be regarded as primary phenomena. (auth)

29610 (EURAEC-1040) STUDY OF CERTAIN PROBLEMS CONCERNING THE OXIDATION OF METALS AND APPLICATION OF IMPEDANCE MEASUREMENTS METHODS TO THE STUDY OF THE RESISTANCE TO CORROSION IN AN AQUEOUS MEDIUM. Quarterly Report No. 1, January 1–April 30, 1964. (Brussels. Université). Work Performed under United States–Euratom Joint Research and Development Program. Contract 012-63-10-TEEB. 12p. (A translation)

The development of electrolytic cells containing platinum electrodes is discussed. The cells are to be used in studying electrochemical corrosion of metals. (N.W.R.)

29611 QUANTITATIVE ELECTRODEPOSITION OF URANIUM ON INTERMEDIATE FLUOROHYDRIDES. Rafael Gaeta and Francisco Manero (Junta de Energia Nuclear, Madrid). Anales Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 60: 45-50(Jan.-Feb. 1964). (In Spanish)

Equipment and methods for the electrodeposition of very thin layers of uranium on stainless steel are described. Under the best working conditions and for a maximum weight of 100 $\mu g/cm^2$, the method was quantitative, with the layers strongly adherent and uniform. The layer reproductiveness was good; the standard deviation was 0.7%. (auth)

29612 X-RAY INVESTIGATION OF THE TRANSITION OF CsCl AT 469°C. Jorma Poeyhoenen and Asko Ruuskanen (Univ. of Turku, Finland). Ann. Acad. Sci. Fennicae, Ser. A VI, 146: 1-12(1964).

Values of the lattice parameters of the modifications I and II of CsCl at temperatures of 20° and from 395 to 508°C were determined by using Debye-Scherrer method. The measuring temperatures were obtained by means of stationary flow of hot air. In the transition at 469°C, for the change of volume the value 0.0470 cm^3/g (17.4%) was calculated from the experimental data. The value of the lattice parameter, 7.074 ± 0.005 Å, found for the modification I at the transition temperature, is considerably greater than the values reported previously. (auth)

29613 IR SPECTRUM AND INTERMOLECULAR INTERACTIONS IN $CDCl_3$-PROTON ACCEPTORS SYSTEM. K. Szczepaniak (Technical Univ., Warsaw). Bull. Acad. Polon. Sci., Ser. Sci., Math., Astron. Phys., 12: 189-96 (1964).

Intermolecular interactions in systems intermediate between those with prevailing interactions of the Van der Waals forces type and those in which well defined hydrogen bonds are present were studied. Measurements were made on mixtures of d-chloroform with strong proton acceptors and neutral solvent using a prism-grating spectrometer. The spectra of the proton acceptors in solution with $CHCl_3$ were also obtained. (D.C.W.)

29614 PROTON RESONANCE SPECTRA OF PARAMAGNETIC COMPLEXES IN AQUEOUS SOLUTION. R. S. Milner and L. Pratt (Imperial Coll. of Science and Tech., London). Discussions Faraday Soc., No. 34, 88-95(1962).

Some proton resonance spectra of paramagnetic complexes are discussed, and a qualitative explanation of the large shifts observed is given. The spectra can sometimes give information about the structure of complexes in solution, and also show the relative amounts of different species. The line positions appear to be sensitive to the conformation of the ligand groups. The changes with pH observed in complexes with polydentate amino acids can be explained by a decrease in the mobility of the ligand as chelation increases. The effects of proton exchange and electron exchange are mentioned briefly. (auth)

29615 CHEMICAL APPLICATIONS OF NUCLEAR ELECTRON DOUBLE RESONANCE. R. E. Richards and J. W. White (Oxford Univ.). Discussions Faraday Soc., No. 34, 96-103(1962).

Overhauser effects can be observed for both the proton and fluorine nuclei in a solution of potassium trifluoroacetate in dimethyl formamide when the electron resonance of added 2:5 ditertiary butyl parabenzosemiquinone is saturated. The proton resonances are always reversed but the fluorine resonances can be either enhanced or reversed. This is explained as the result of a proton-fluorine dipolar coupling in solution. A method of calculating the strength of the coupling was developed and its dependence on the concentration of the $CF_3 \cdot COO^-$ ions was measured. The relaxation times so determined were used to obtain an estimate of the mean distances in solution between the fluorine, proton, and electron spins. (auth)

29616 NUCLEAR MOMENTS IN FLUCTUATING FIELDS. John S. Waugh (Massachusetts Inst. of Tech., Cambridge). Discussions Faraday Soc., No. 34, 160-4 (1962).

The effects of time-dependent perturbations, particularly chemical reactions, on high resolution nmr spectra are discussed. Some speculations are made about the possibility of observing ortho-para conversion in molecules larger than H_2 and about the implications of this process for the motions of molecules in fluids. (auth)

29617 DEVELOPMENT OF A Cb–Ce ELECTRODE FOR MELTING AND WELDING Cb AND Cb-BASE ALLOYS IN VACUUM. Simon S. Aconsky and James R. Doyle (Pratt and Whitney Aircraft Div., United Aircraft Corp., Middletown, Conn.). Electrochem. Technol., 1: 116-22(Mar.-Apr. 1963).

A nonconsumable electrode of Nb-8 Ce, capable of sustaining a stable arc under conditions of dynamic vacuum, was developed. As either a melting or welding electrode, marked purification of niobium and niobium alloys was accomplished. A mechanism for the operation of this electrode, both for its ability to sustain a vacuum arc and to purify reactive and refractory metals, is proposed on the basis of its thermodynamic and thermionic properties. (auth)

29618 SOME REDUCTION REACTIONS OF TUNGSTEN OXIDE IN ARGON. N. F. Cerulli and C. K. Lui Wei (Westinghouse Electric Corp., Bloomfield, N. J.). Electrochem. Technol., 1: 247-52(July-Aug. 1963).

The reduction reactions of WO_3 with Al, W, Th, Ta, and TaC that take place in an inert (argon) atmosphere were followed by means of x-ray diffraction analyses. Approximate reaction temperature ranges were established and reaction products identified. In general, the oxides $W_{18}O_{49}$ or $W_{20}O_{58}$ were found as intermediate products during the reductions except for the Th reaction where no intermediate oxide was observed. In the case of the TaC reaction, both CO and CO_2 were evolved during the course of the reduction. The feasibility of using heats of reaction to pre-

pare tungsten-base alloy dispersions or alloys is discussed. (auth)

29619 THE ELECTROCHEMISTRY OF MOLTEN SALTS. Thomas B. Reddy (Bell Telephone Labs., Inc., Murray Hill, N. J.). Electrochem. Technol., 1: 325-51 (Nov.-Dec. 1963).

A survey of fused-salt electrochemistry was made and advances in this field are summarized. Studies of transport processes served to elucidate the nature of ionic liquids. EMF measurements provided thermodynamic data and information on ionic association in fused salts. The application of modern techniques to the study of electrode kinetics in fused salts proved necessary because of the high values of exchange currents for electrode reactions at high temperature, and electroanalytical methods were useful in the study of electrode processes under conditions where mass transport is limiting. Fused-salt electrolytic procedures hold promise for the preparation of unusual compounds, metals, and alloys. There was research on high-temperature power systems. Advances were made in the field of fused-salt fuel cells, but many engineering problems must be solved before long-term trouble-free operation with inexpensive fuels is possible. Thermally regenerated galvanic cells using molten salts are in an early stage of development. (auth)

29620 REFLECTANCE OF ANODIZED TITANIUM AND BERYLLIUM. J. Janssen, J. Luck, and R. Torborg (Minneapolis-Honeywell Regulator Co., Hopkins, Minn.). Electrochem. Technol., 1: 368-75(Nov.-Dec. 1963).

The effect of anodizing variables on the spectral reflectance of anodic coatings on A11OAT and B12OVAC titanium, QMV beryllium, and beryllium plus 1% copper was studied to determine the variation in reflectance that could be achieved. An integrating hemisphere reflectometer was devised, and normal reflectance was measured over the range of 0.4 to 22μ in a vacuum of 10^{-5} torr with specimen temperatures ranging from 100 to 1300°F. The type of anodizing bath was found to be the most important variable. All coatings exhibited relatively high solar absorptance and low infrared emittance. The sodium hydroxide process on A11OAT titanium resulted in a solar absorbance of 0.68 with an emittance of about 0.1, making this surface attractive as a solar energy absorber. (auth)

29621 ABSORPTION SPECTRA OF URANIUM(IV) IN OCTAHEDRAL COORDINATION. R. Pappalardo and C. K. Joergensen (Cyanamid European Research Inst., Cologny, Switzerland). Helv. Phys. Acta, 37: 79-103(1964).

Optical absorption spectra of crystals containing octahedrally coordinated U^{4+} ions in triphenylphosphonium complex salts are reported for the region 2.5 to 0.3 μ, both at room temperature and 78°K. Vibrational frequencies for the $(UCl_6)^{2-}$ and $(UBr_6)^{2-}$ groups were found superimposed on to the electronic transitions. General properties of the spectra in connection with the $5f^2$ energy levels are discussed. (auth)

29622 PREPARATION AND PROPERTIES OF SOME RARE-EARTH TITANATES. Hua Hsueh Tung Pao, No. 5, 54-7(1964). (In Chinese)

29623 PRODUCTION OF URANIUM HEXAFLUORIDE IN A FLUIDIZED BED REACTOR BY THE REACTION OF URANIUM TETRAFLUORIDE WITH OXYGEN. Charles D. Scott, Joseph B. Adams, and James C. Bresee (Oak Ridge National Lab., Tenn.). Ind. Eng. Chem., Process Design Develop., 3: 266-70(July 1964). (ORNL-TM-544)

The production of UF_6 by the reaction $2UF_4 + O_2 = UF_6 + UO_2F_2$ was investigated to determine the engineering feasibility after initial laboratory studies indicated small-scale workability. The process can be used for the production of UF_6 without the use of elemental fluorine. Engineering feasibility was demonstrated in a continuous, 4-inch diameter fluidized-bed reactor in which either dry air or oxygen was used as the oxidizing agent–fluidizing gas with refined UF_4 feed. Greater than 90% of the theoretical amount of UF_6 formed was collected in cold traps, and the remainder was accounted for by side reactions. To demonstrate the feasibility of continuous operation, the fluidized-bed reactor was operated in one test for 56.8 hours, and 33.8 kg of UF_6 were collected in the system cold traps. Methods were derived for determining reaction rates in the fluid bed and the resulting first-order dependence of the reaction rate showed good agreement with earlier laboratory thermogravimetric studies. (auth)

29624 EMISSION SPECTRUM OF MgCl: A NEW DOUBLET SYSTEM. V. Satyanarayana Rao and P. Tiruvenganna Rao (Andhra Univ., Waltair, India). Indian J. Phys., 37: 640-4(Dec. 1963).

A new doublet system of bands attributed to MgCl molecule was observed in the visible region λ5000–4550 in the high frequency discharge. From the vibrational analysis of the system it is concluded that the lower state of this system is the same as the first excited $A^2\Pi$ state of MgCl with a doublet separation of 55 cm^{-1}. The approximate vibrational constants of the upper state are estimated as $\omega_e' = 563$ cm^{-1} and $x_e'\omega_e' = 5.5$ cm^{-1}. The electronic structures of the ground and excited states of MgCl are discussed in relation to those of BeF and MgF. (auth)

29625 FORMATION AND SPECTRA OF URANYL(V) CHLORIDE IN MOLTEN CHLORIDE SOLVENTS. Donald A. Wenz, Max D. Adams, and Robert K. Steunenberg (Argonne National Lab., Ill.). Inorg. Chem., 3: 989-92(July 1964).

Additional studies were made of the thermal decomposition of UO_2^{2+} in molten chloride solutions to form UO_2^+ and chlorine. An equilibrium constant of $1.2 \pm 0.6 \times 10^{-4}$ atm at 650°C was obtained in molten LiCl–KCl eutectic. Further decomposition of UO_2^+ to UO_2 and chlorine was observed under vacuum at 750°C. Molar absorptivities are given for UO_2^+ spectra in a number of molten chloride solvents at various temperatures. Variations of the spectrum with changes in the solvent and temperature are attributed to differences in their influence on the U–O bonds. (auth)

29626 MAGNETIC SUSCEPTIBILITIES OF NEODYMIUM(II) CHLORIDE AND IODIDE. Robert A. Sallach and John D. Corbett (Ames Lab., Ames, Iowa). Inorg. Chem., 3: 993-5(July 1964). (IS-802)

The magnetic susceptibilities of $NdCl_2$ and $NdI_{1.95}$ over the range 77 to 550°K, as well as those of $NdCl_3$ and NdI_3 between 77 and 480°K were determined by a standard Gouy technique. The trichloride and triiodide obeyed the Curie–Weiss relationship and yielded 3.78 B.M. (Δ = 31°) and 3.72 B.M. (Δ = 9°), respectively, for the cation moment, which compared with the theoretical value of 3.62 B.M. for the $^4I_{9/2}$ ground state of Nd^{3+}. Thermal population of the first excited state was important in the neodymium(II) state, as predicted by van Vleck. The data for both salts were well described with moments of 2.87 and 5.36 B.M. for the ground and excited states and $\Delta E/k$ = 1400°K. The theoretical values were 2.68 and 4.93 B.M. for the $^5I_4$ and $^5I_5$ states, respectively. The results confirmed the presence of the reduced $4f^4$ ion Nd^{2+} in the neodymium(II) halides that is suggested by the conduction properties of the solid

and liquid salts. The reported susceptibility of Pm^{3+} was also considered. (auth)

29627 COMPLEXES OF THE RARE EARTHS. VII. 2-PICOLYLIMINODIACETIC ACID AND 6-METHYL-2-PICOLYLIMINODIACETIC ACID. Larry C. Thompson (Univ. of Minnesota, Duluth). Inorg. Chem., 3: 1015-18 (July 1964).

The solution stabilities of the rare earth chelates of 2-picolyliminodiacetic and 6-methyl-2-picolyliminodiacetic acids were measured at 25° and $\mu = 0.1$ (KNO_3). The former ligand apparently functions as a quadridentate ligand in both the 1:1 and 2:1 complexes, whereas the 6-methyl group apparently hinders the coordination of the pyridine nitrogen in the second ligand. The affinity of the rare earth ion for the heterocyclic nitrogen atom appeared to be approximately the same as for the hydroxyl group in the analogous compound N-hydroxyethyliminodiacetic acid. (auth)

29628 CHLORO COMPLEXES OF NITROSYLRUTHENIUM. E. E. Mercer, W. M. Campbell, Jr., and R. M. Wallace (E. I. du Pont de Nemours & Co., Aiken, S. C.). Inorg. Chem., 3: 1018-24(July 1964). (TID-18817)

An investigation of the nitrosylruthenium chloro complexes formed in hydrochloric acid solutions showed the existence of five monomeric complexes. The mono-, di-, tri-, tetra-, and pentachloro complexes were isolated by ion exchange and shown to have the formulas $RuNOCl(H_2O)_4^{2+}$, $RuNOCl_2(H_2O)_3^{+}$, $RuNOCl_3(H_2O)_2$, $RuNOCl_4(H_2O)^{-}$, and $RuNOCl_5^{2-}$ in acid media. The complex $RuNOCl_4(H_2O)^{-}$ was a weak acid that dissociated to produce $RuNOCl_4(OH)^{2-}$ with a dissociation constant of 9.5×10^{-7}. $RuNOCl_3(H_2O)_2$ was a weak dibasic acid that dissociated to produce $RuNOCl_3(H_2O)(OH)^{-}$ and $RuNOCl_3(OH)_2^{2-}$ with successive dissociation constants of 1.1×10^{-5} and 3.4×10^{-6}. One other chloro complex was detected but was not characterized. (auth)

29629 THE SYSTEM BERYLLIUM OXIDE–WATER AT MODERATE TEMPERATURES AND PRESSURES. Herbert W. Newkirk (Univ. of California, Livermore). Inorg. Chem., 3: 1041-3(July 1964). (UCRL-7368)

The phase relationships that exist at moderate temperatures and pressures in the system BeO–H_2O using β–$Be(OH)_2$ as starting material, are reported. It was concluded that the stability region of the BeO phase is well within the capabilities of currently available pressure equipment. Differences in particle size, surface area, and impurity content among starting materials had little effect on phase relationships in this system. The results confirmed the feasibility of growing BeO by hydrothermal techniques. (M.C.G.)

29630 OBSERVATIONS ON THE COMPLEX BETWEEN URANYL AND CHLORITE IONS. Gilbert Gordon and David M. H. Kern (Univ. of Maryland, College Park). Inorg. Chem., 3: 1055-6(July 1964).

During some experiments in which aqueous solutions of uranium(IV) were being oxidized by ClO_2^-, a transient yellow color was observed. This color was interpreted in terms of a complex between UO_2^{2+} and ClO_2^-. A direct proportionality between absorbancy enhancement and the product of the UO_2^{2+} and actual ClO_2^- concentration persisted over a wide concentration range. This demonstrated that a relatively small amount of the ClO_2^- and UO_2^{2+} is tied up in the complex. (M.C.G.)

29631 PREPARATION AND PROPERTIES OF THE $Ln_2Ti_2O_7$-TYPE RARE EARTH TITANATES. L. H. Brixner (E. I. du Pont de Nemours & Co., Wilmington, Del.). Inorg. Chem., 3: 1065-7(July 1964).

$M_2Ti_2O_7$ compounds of the rare earths were prepared and lattice parameters obtained from x-ray powder diffraction data. The resistivity and dielectric constant values of each compound were determined on sintered compacts. (M.C.G.)

29632 Cl^{35} ISOTOPE IN $NaClO_3$ AS NUCLEAR Q. R. THERMOMETER. H. Budak (Univ. of Istanbul). Istanbul Univ. Fen Fak. Mecmuasi, Seri C, 28: 142-8(July-Oct. 1963).

The temperature dependence of the nuclear quadrupole resonance frequency of the ^{35}Cl isotope in $NaClO_3$ and its application to temperature measurement, were investigated. Signal to noise ratio corresponding to this sample was good. A superregenerative circuit was used. The error of the resonance frequency determination was 30 to 90 c/sec for the range 25 to 45°C, which corresponds to an error of the temperature determination of 0.007 to 0.021°C. These errors are partly due to the errors made with the mercury thermometer for which the only correction applied was for the non-heated part of the mercury. The temperature at which the nuclear quadrupole resonance frequency of this sample is exactly 30 Mc/sec was determined to be $t_{(30M)} = 7.303 \pm 0.003$°C. Since this frequency (30 Mc/sec) can be controlled by one of the standard frequency emitters, a new type of constant temperature point may be defined. (auth)

29633 ON THE THEORY OF SPIN RELAXATION OF GAS MOLECULES: THE STRONG-COLLISION LIMIT. Jack H. Freed (Cambridge Univ., Eng. and Cornell Univ., Ithaca, N. Y.). J. Chem. Phys., 41: 7-13(July 1, 1964).

A model of spin relaxation of gas molecules based upon an assumption of strong collisions was developed. A relaxation matrix formally similar to that of Redfield, but with different spectral densities, was obtained. The nuclear magnetic relaxation of gaseous ortho-hydrogen is discussed in terms of these results, and it is shown that, in general, molecules in different J states are expected to exhibit different relaxation times (a conclusion that is independent of the strong collision assumption) whenever the collision mechanism is effective only in reorienting J but not in changing its magnitude. Otherwise statistical averages of relaxation times are obtained. Relaxation of more complex molecules is also discussed. (auth)

29634 PERTURBATION THEORY OF THE HEATS OF MIXING OF FUSED SALTS. H. Ted Davis (Univ. of Minnesota, Minneapolis) and Stuart A. Rice. J. Chem. Phys., 41: 14-24(July 1, 1964).

A theory of the thermodynamic properties of molten salts including the effects of short-range attractive interactions was developed. The analysis was built on the work of Reiss, Katz, and Kleppa, who showed that many of the thermodynamic properties of molten salt mixtures could be understood in terms of a model ionic melt consisting of rigid impenetrable ions interacting with a long-range Coulomb potential. The RKK theory is inadequate for the description of recent experimental measurements of the heats of mixing of salts whose short-range attractive interactions are expected to be significant. Most of the molten salt data of Kleppa et al. were fitted to the following equation for the heats of mixing: $\Delta H_m = x_1x_2(a + bx_1)\delta_{12}^2 + x_1x_2c$, $\delta_{12} = (\lambda_2 - \lambda_1)/\lambda_1\lambda_2$, with x, the mole fraction of the ith component, $a < 0$, $b < 0$, and $c > 0$. The major contribution to a arises from Coulomb interactions, and is accounted for by the RKK analysis which, however, does not completely account for b and gives $c = 0$. Using a perturbation analysis it is shown that the term c and part of b arise from short-range interactions between ions; the theoretical relation-

ship deduced reproduces the observed composition dependence of the heat of mixing shown above. The qualitative deductions, which can be made from the formal analysis, are all in agreement with the available experimental data. It is also shown that there is a short-range potential contribution to the leading term (ax_1x_2) and explicit relationships for the coefficients a and b are given. A method of using the theorem of corresponding states to obtain information about the short-range coupling is suggested. (auth)

29635 POTENTIAL FUNCTION FOR THE STRETCHING REGION IN POTASSIUM ACID FLUORIDE. James A. Ibers (Brookhaven National Lab., Upton, N. Y.). J. Chem. Phys., 41: 25-8(July 1, 1964).

A simple potential function was used to fit the observed fundamentals and overtones of the asymmetric and symmetric stretching frequencies of the bifluoride ion in KHF_2 and KDF_2 and also to account for the difference in mean FHF and FDF bond lengths. The agreement with experiment was good, considering the simplicity of the function and the uncertainties in the data. This potential function was based on a linear symmetric model for the bifluoride ion and there is thus no spectroscopic evidence in favor of an asymmetric model. (auth)

29636 LATTICE HEAT CAPACITY OF SOLID HYDROGEN. Guenter Ahlers (Univ. of California, Berkeley). J. Chem. Phys., 41: 86-94(July 1, 1964).

The lattice heat capacity of solid hydrogen was measured at zero pressure, and at three constant volumes. The measurements extended from 2°K to the triple point for the zero-pressure data, from 2°K to the melting temperature at 22.56 cc/mole, and from 4 to 20°K at 19.83 and 18.73 cc/mole. The Debye thetas at 0°K are 128, 169, and 189°K at 22.56, 19.83, and 18.73 cc/mole, respectively. The temperature dependences of the Debye thetas are similar to those for other simple solids. Some information about other thermodynamic properties was obtained from the heat capacities. The isothermal compressibility at 16.35°K at the melting pressure was essentially the same as at 4.2°K at the same pressure. The thermal expansion coefficient at 82 atm appeared to have a maximum at about 12°K. At zero pressure the thermal expansion coefficient was approximately proportional to the temperature. The thermodynamic expression for the Grüneisen relation was not obeyed in solid hydrogen. (auth)

29637 LATTICE VIBRATIONS OF LaF_3. H. H. Caspers, R. A. Buchanan, and H. R. Marlin (Naval Ordnance Lab., Corona, Calif.). J. Chem. Phys., 41: 94-9(July 1, 1964).

The infrared spectrum of LaF_3 in the region from 50 to 575 cm^{-1} is presented. Four strong absorption bands at 185, 208, 275, and 358 cm^{-1} were observed. The Raman spectrum was investigated and five lines were found at 75, 292, 310, 365, and 392 cm^{-1}. A group theoretical analysis was carried out for the two slightly different crystal structures proposed for lanthanum trifluoride. The room temperature data seemed to favor the more symmetrical bimolecular unit cell. Symmetry coordinates are discussed and some tentative assignments made. (auth)

29638 ION-MOLECULE REACTIONS IN METHANOL AND ETHANOL. Keith R. Ryan, L. Wayne Sieck, and Jean H. Futrell (Aerospace Research Labs., Wright-Patterson AFB, Ohio). J. Chem. Phys., 41: 111-16(July 1, 1964).

Proton-transfer reactions in the methanol and ethanol systems were investigated by the techniques of conventional mass spectrometry. Using isotopically substituted methanols, relative transfer probabilities from the carbon and hydroxyl positions of the parent molecule ion were found to be 1.00 and 0.81, respectively. The reaction involving CH_3OH^+ was investigated quantitatively. In ethanol, only $C_2H_4OH^+$ were found to participate in proton transfer processes. Other secondary ions formed in the high-pressure mass spectrum of methanol and ethanol are reported, as well as the rate constants for the various proton-transfer processes. (auth)

29639 PHOTOLUMINESCENCE OF LANTHANIDE COMPLEXES. II. ENHANCEMENT BY AN INSULATING SHEATH. F. Halverson, J. S. Brinen, and J. R. Leto (American Cyanamid Co., Stamford, Conn.). J. Chem. Phys., 41: 157-63(July 1, 1964).

The effect of an "insulating sheath" in reducing radiationless energy losses from a lanthanide chelate is postulated and techniques for developing this sheath are described. Data on luminescence of various europium chelates and synergic agent complexes are presented, which demonstrate the efficacy of the sheath. A quantum efficiency approaching 80% is obtained for photoluminescence of a low viscosity hydrocarbon solution at room temperature. (auth)

29640 EXPERIMENTAL DETERMINATION OF THE FIELD GRADIENT AT THE DEUTERON IN FORMALDEHYDE. W. H. Flygare (Univ. of Illinois, Urbana). J. Chem. Phys., 41: 206-14(July 1, 1964).

A high-resolution microwave spectrograph was constructed to observed small perturbations in rotational energy levels. High-resolution spectroscopy on OCD_2 yielded the following values of the quadrupole coupling constants in the OCD_2 principal inertial axis system: $\chi_{aa} = -13 \pm 4$, $\chi_{bb} = 98 \pm 4$, and $\chi_{cc} = -85 \pm 4$ kc/sec. The spin-rotation coupling constants in OCD_2 were calculated from the values for the proton obtained from the beam-maser spectroscopy on OCH_2. Data on the $2_{12} \rightarrow 2_{11}$ transition in OCHD were then analyzed and the following coupling constants in the OCHD principal inertial axis system obtained: $\chi_{a'a'} = 9 \pm 2$, $\chi_{b'b'} = 76 \pm 2$, and $\chi_{c'c'} = -85 \pm 2$ kc/sec. These data show that the principal field-gradient axis system coincides with the bond axis system within experimental error. The principal field-gradient components all in units of esu cm^{-3} are $q_{\alpha\alpha}$(C—H bond axis) = 8.45×10^{14}, $q_{\beta\beta} = -4.15 \times 10^{14}$, and $q_{\gamma\gamma}$ (perpendicular to molecular plane) = -4.30×10^{14}. (auth)

29641 STRUCTURE OF THE AQUEOUS PERTECHNETATE ION BY RAMAN AND INFRARED SPECTROSCOPY. RAMAN AND INFRARED SPECTRA OF CRYSTALLINE $KTcO_4$, $KReO_4$, Na_2MoO_4, Na_2WO_4, $Na_2MoO_4 \cdot 2H_2O$, AND $Na_2WO_4 \cdot 2H_2O$. R. H. Busey and O. L. Keller, Jr. (Oak Ridge National Lab., Tenn.). J. Chem. Phys., 41: 215-25(July 1, 1964).

The Raman crystal of $KTcO_4$, $KReO_4$, Na_2MoO_4, Na_2WO_4, $Na_2MoO_4 \cdot 2H_2O$, and $Na_2WO_4 \cdot 2H_2O$, and the Raman aqueous spectra of TcO_4^- and MoO_4^{2-} were observed. Infrared spectra of Nujol mulls of all the salts were measured in the rock salt region. Infrared spectra in the CsBr region were also obtained for Na_2MoO_4 and Na_2WO_4. For the tetrahedral ions (T_d symmetry) of the latter salts $\nu_2(e) > \nu_4(f_2)$, which represents an inversion of the usual order. Examination of all the spectra led to the conclusion that the Raman spectrum of aqueous pertechnetate ion, which shows only two lines, represents the spectrum of tetrahedral TcO_4^- ion perturbed by the close association of water molecules. The appearance of two instead of four Raman lines in the spectrum is shown to result from the accidental degeneracy of $\nu_1(a_1)$ and $\nu_2(f_2)$ vibrations. The $\nu_2(e)$ line is not detected

probably because of its low intensity and broadness. The observation of three rather than the expected four Raman lines for molybdate ion is similarly believed to be due to the low intensity and broadness of the ν_2(e) line. This explanation is also offered as an alternative explanation for the absence of the fourth line in the Raman spectrum of ReO_4^-(aq) and WO_4^{2-}(aq) to that previously given, namely, that ν_2(e) and ν_4(f_2) are sufficiently close together that they are unresolved. (auth)

29642 REACTION RATES OF XENON FLUORIDES WITH OXIDES OF NITROGEN. Harold S. Johnston and Robert Woolfolk (Univ. of California, Berkeley). J. Chem. Phys., 41: 269-73(July 1, 1964).

The rate of reaction of XeF_4 and XeF_2 with NO and with NO_2 was studied between 300 and 350°K at pressures between 0.1 and 30 mm. The second-order rate constant at 300°K and the activation energies are, respectively: XeF_4 + NO, 3 liters/mole sec, 7 kcal/mole; and XeF_2 + NO, 0.3 liters/mole sec, 10 kcal/mole. The rate of NO_2 with XeF_4 and XeF_2 was too slow to observe, $k < 0.01$ liter/mole sec. The fluorides of xenon react with the oxides of nitrogen much more slowly than F_2 reacts with NO or NO_2. By means of a Polanyi-Semenov plot, the reactions of XeF_4, XeF_2, and F_2 with oxides of nitrogen were combined to give an estimate of the successive dissociation energies of XeF_4, which are (kcal/mole): $XeF_4 \rightarrow XeF_3 + F$, 48; $XeF_3 \rightarrow XeF_2 + F$, 15; $XeF_2 \rightarrow XeF + F$, 54; and $XeF \rightarrow Xe + F$, 11. From these kinetic and thermochemical data a strong case could be made for the stepwise reduction of XeF_4. (auth)

29643 EVIDENCE FOR EIGHTFOLD COORDINATION IN EUROPIUM CHELATES. C. Brecher, A. Lempicki, and H. Samelson (General Telephone and Electronics Labs., Inc., Bayside, N. Y.). J. Chem. Phys., 41: 279-80(July 1, 1964).

Evidence for high coordination in europium chelates is discussed. Eight-fold coordination of the benzoylacetone and dibenzoylmethide chelates was indicated by both their chemical composition and their emission spectra. The structure of the $^5D_0 - {}^7F_2$ transition was consistent with selection rules derived from a dodecahedral arrangement of eight oxygens around the central europium atom. (M.C.G.)

29644 THE ANODIC DISSOLUTION AND PASSIVATION OF SMOOTH PLATINUM. I. ANOMALOUS RESULTS FROM THE RADIOTRACER TECHNIQUE. T. Dickinson, R. C. Irwin, and W. F. K. Wynne-Jones (Univ. of Newcastle-upon-Tyne, Eng.). J. Electroanal. Chem., 7: 297-301(Apr. 1964).

Radioactive platinum was employed in a study of the electrochemical dissociation of smooth platinum and the amount of metal dissolving was determined by activity measurements. Correlation of the measurements of radioactivity with the coulometric measurements was found to be complicated by the presence of highly radioactive foreign atoms in the platinum. Methods of eliminating this complication are discussed. (auth)

29645 THEORETICAL CALCULATIONS OF THE SEPARATION FACTORS IN THE HYDROGEN EVOLUTION REACTION FOR THE SLOW DISCHARGE MECHANISM. John O'M. Bockris and S. Srinivasan (Univ. of Pennsylvania, Philadelphia). J. Electrochem. Soc., 111: 844-53(July 1964).

Theoretical calculations of the electrolytic separation factors (S) for the slow discharge mechanism were carried out following the lines of earlier calculations by Horiuti et al. Previous calculations neglected the effect on S of the step following the discharge step, the real stretching frequency of the transition state, and tunneling corrections. The calculated S values differed from previous results mainly due to the inclusion of the real stretching frequency of the transition state. The H-T separation factors were more useful than the H-D separation factors in determining the mechanism. (auth)

29646 THEORETICAL CALCULATIONS OF THE SEPARATION FACTORS IN THE HYDROGEN EVOLUTION REACTION FOR THE SLOW ELECTROCHEMICAL DESORPTION MECHANISM. John O'M. Bockris and S. Srinivasan (Univ. of Pennsylvania, Philadelphia). J. Electrochem. Soc., 111: 853-8(July 1964).

Separation factors (S) for the slow electrochemical desorption mechanism at low and intermediate overpotentials were calculated for Ni. The S values were distinctly separated from those for all other mechanisms. The results were consistent with variation of percentage coulombic energy of all interactions. The separation factor method alone could not be used to distinguish between either of the rate-determining steps in a linked discharge electrochemical desorption mechanism. A knowledge of the degree of coverage was also required. (auth)

29647 THEORETICAL CALCULATIONS OF THE SEPARATION FACTORS IN THE HYDROGEN EVOLUTION REACTION FOR THE SLOW RECOMBINATION MECHANISM. John O'M. Bockris and S. Srinivasan (Univ. of Pennsylvania, Philadelphia). J. Electrochem. Soc., 111: 858-63(July 1964).

The theoretical calculations of H/D and H/T separation factors were carried out on the metals Ni and Pt, following the lines of earlier calculations by Okamoto et al. The effect of variations in the metal-metal internuclear distances and the coulombic exchange energy ratio on the separation factor was small. Tunneling corrections were also made. The calculated H/T separation factor on Pt was in agreement with the experimentally determined value. The theoretically predicted separation factors for a slow molecular hydrogen diffusion mechanism were not distinctly separated from the values for a slow recombination mechanism. (auth)

29648 Ta_2O_5 FILMS FORMED WITH NONSTEADY POTENTIALS. D. A. Vermilyea (General Electric Co., Schenectady, N. Y.). J. Electrochem. Soc., 111: 883-11 (July 1964).

Two characteristics of anodic Ta_2O_5 films formed with nonsteady potential are described. Observation of a different type of film formed with alternating potential is reported. Films formed with nonsteady potential were thinner for a given peak formation voltage than films formed at a steady voltage equal to the peak voltage; these films also dissolved more slowly in hydrofluoric acid. Multicolored films were formed when alternating potentials were applied to solutions containing alkali ions at fairly high concentrations and at a high current density. (M.C.G.)

29649 VIBRATION-ROTATION BANDS OF DEUTERIUM CYANIDE AND HYDROGEN CYANIDE. Arthur G. Maki, Earle K. Plyler, and Robert Thibault (National Bureau of Standards, Washington, D. C.). J. Opt. Soc. Am., 54: 869-76(July 1964).

Six vibration–rotation bands of DCN between 2 and 6 μ were analyzed. All the rotational constants were obtained through the terms quadratic in vibrational quantum num-

bers. Two quadratic and seven cubic vibrational anharmonic constants were obtained explicitly. Seven combinations of quadratic and cubic vibrational constants were obtained. Data are given on the analysis of the two parallel fundamental bands of $D^{13}CN$, as well as the ν_3 bands of $DC^{15}N$, $H^{13}CN$, and $HC^{15}N$. $\Delta-\Delta$ transitions of both DCN and HCN in the ν_3 fundamental regions were analyzed. The splitting of the Δ levels was clearly observed for the first time and is in agreement with the *l*-type resonance calculations. The line structure of the Q branches of both $\Pi-\Pi$ and $\Delta-\Delta$ "hot bands" was also resolved. By means of the Ritz principle the levels $2\nu_2^0$, $2\nu_2^2$, and ν_2^1 of DCN and $2\nu_2^2$ of HCN were determined. (auth)

29650 PHOTOIONIZATION CROSS SECTIONS OF HELIUM. James A. R. Samson (Geophysics Corp. of America, Bedford, Mass.). J. Opt. Soc. Am., 54: 876-8(July 1964).

The photoionization cross sections of helium were measured from threshold down to 260 Å. At the spectral head, the cross section was found to be 7.3×10^{-18} cm^2. The experimental results are compared to available theoretical data. The oscillator strength for transitions into the ionization continuum were estimated from threshold to 0.01 Å using the present and previously published data. A continuum f value of 1.54 was obtained. Applying the Thomas–Kuhn sum rule, the total oscillator strength for all discrete transitions was determined to be f = 0.46. (auth)

29651 FAR-ULTRAVIOLET REFLECTANCE OF SEVERAL TRANSITION METALS. L. J. LeBranc, J. S. Farrell, and D. W. Juenker (Univ. of Notre Dame, Ind.). J. Opt. Soc. Am., 54: 956-7(July 1964).

The far ultraviolet reflectance spectra of Mo, W, Ta, and Re were measured by determining the ratio of photoelectric emission currents of two closely identical specimens, one of which was exposed to the output illumination of a vacuum monochromator, while the other received the light reflected specularly from the first. (D.C.W.)

29652 INTERFEROMETRICALLY MEASURED THORIUM WAVELENGTHS. A. Giacchetti, M. Gallardo, M. J. Garavaglia, A. Gonzalez, F. P. J. Valero, and E. Zakowicz (Universidad Nacional de La Plata, Argentina). J. Opt. Soc. Am., 54: 957-9(July 1964).

The wavelengths of 129 thorium lines excited in an electrodeless discharge lamp were measured interferometrically. The lines fall into two groups –82 lines from 3400 to 4600 Å and 47 lines from 2680 to 3280 Å. The measured vacuum wavelengths and calculated air wavelengths are tabulated, together with relative intensities taken from the monograph of Zalubas. (D.C.W.)

29653 A THIN-WALLED SPECIMEN CONTAINER FOR NEUTRON SCATTERING STUDIES OF LIQUIDS AT HIGH TEMPERATURES AND PRESSURES. S. J. Cocking and A. R. Ball (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Sci. Instr., 41: 376-8(June 1964).

The container described uses a grid formed of thin-walled stainless-steel tubing to retain liquid specimens at elevated temperature and pressure. The sample is pressurized by means of a standard compressed-air cylinder, and uniform heating of the specimen is achieved by passing electric current along the tube wall. Thermal expansion of the specimen is accommodated while retaining a completely liquid-filled container. Tests with water as the specimen show that the design can be used up to a temperature of 300°C and pressure of 1800 psi. Volume changes of the liquid can be detected and measured with great sensitivity (~0.5%), so that the container has been used, during testing, to measure the compressibility of water at several temperatures, up to 260°C. (auth)

29654 ClF TARGET IN THE MOLECULAR SOLID STATE. Kenzo Sugimoto, Akira Mizobuchi, and Kozi Nakai (Osaka Univ.). Japan J. Appl. Phys., 3: 303-4(May 1964).

A ClF target with a purity of more than 90% was prepared for an experiment on the quadrupole moment of the second excited state of ^{19}F. The target assembly and preparation are described. (D.C.W.)

29655 A CONVENIENT METHOD FOR PRODUCING SMALL QUANTITIES OF Cs METAL. Lili M. Császar and Károly Rózsa. Magy. Tud. Akad. Kozp. Fiz. Kut. Int. Kozlemen., 12: 175-9(1964). (In Hungarian)

The production of Cs metal of appropriate purity for photographing molecular spectra is described. $Cs_2Cr_2O_7$ as the starting material was transformed into CsN_3, from which Cs was produced by thermal dissociation. (auth)

29656 AN ELECTROLYTIC METHOD OF PREPARING MÖSSBAUER SOURCES AND ABSORBERS. J. Stephen (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nucl. Instr. Methods, 26: 269-73(Mar. 1964). (AERE-R-4308)

A description of an electrolytic method for the preparation of sources and absorbers for studying the Mössbauer effect associated with ^{57}Fe under various conditions is presented. (auth)

29657 FAST RECORDING OF NEUTRON DIFFRACTION INTENSITY DATA. R. Chidambaram, A. S. Sequeira, and S. K. Sikka (Atomic Energy Establishment, Trombay, India). Nucl. Instr. Methods, 26: 340-2(Mar. 1964).

A peak counting method for recording neutron diffraction intensity data that achieves almost an order of magnitude of time economy is outlined. The speedier collection of data is of great advantage for crystals that are not very stable and for low temperature work. (C.E.S.)

29658 DEFORMATION BY SLIP IN SINGLE CRYSTALS OF CALCIUM TUNGSTATE. B. Cockayne (Royal Radar Establishment, Great Malvern, Worcestershire, Eng.) and G. E. Hollox. Phil. Mag. (8), 9: 911-16(June 1964).

Plastic deformation of calcium tungstate single crystals was observed to occur by slip on {100} ⟨100⟩ systems at temperatures in the range 800–1000°C. No plastic deformation was observed below 800°C. The operation of these slip systems is correlated with the occurrence of low-angle dislocation boundaries parallel to ⟨100⟩ directions in crystals grown from the melt. (auth)

29659 INFRARED LATTICE VIBRATIONS IN CALCIUM TUNGSTATE AND CALCIUM MOLYBDATE. A. S. Barker, Jr. (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., 135: A742-7(Aug. 3, 1964).

The infrared active lattice vibrations of single-crystal $CaWO_4$ and $CaMoO_4$ were studied by taking polarized reflection spectra in the region 1 to 130 μ. Four infrared phonon modes vibrate with the electric vector E parallel to the c axis and four with E perpendicular to the c axis in each material. A classical oscillator dispersion analysis is carried out to give the mode strengths, frequencies, and linewidths of the eight infrared modes. The frequencies of the eight corresponding longitudinal optic modes are found from the dispersion analysis. A symmetry study of the zero wave vector vibrations is carried out for the Scheelite structure which predicts four infrared modes for E||c axis and four for E⊥c axis as well as 13 Raman modes and 3 inactive modes. A study is made of apparent failure of the classical oscillator model near one of the strong modes. (auth)

29660 NUCLEAR SPIN-LATTICE RELAXATION IN MOLECULAR CRYSTALS. P. K. Sharma and S. K. Joshi (Univ. of Allahabad, India). Physica, 30: 948-52(May 1964).

The spin-lattice relaxation of an arbitrary spin due to the molecular torsional oscillations in pure quadrupole resonance is discussed. Explicit expressions for the spin-lattice relaxation time T_1 are derived for two different forms of correlation function. The first one is based on Bayer's model, and the second makes use of a more physical picture of harmonic oscillator transitions. (auth)

29661 APPARATUS FOR THE DETERMINATION OF DIFFUSION COEFFICIENTS IN FUSED SALTS ($NaNO_3$) AT HIGH PRESSURE. S. B. Tricklebank, L. Nanis, and J. O'M. Bockris (Univ. of Pennsylvania, Philadelphia). Rev. Sci. Instr., 35: 807-10(July 1964).

An apparatus for the determination of diffusion coefficients in fused salts at pressures up to 2 kbar, together with the necessary experimental techniques, is described. Values of the self-diffusion coefficients of ^{22}Na in $NaNO_3$ at 350°C are $(2.10 \pm 0.09) \times 10^{-5}$ cm^2 sec^{-1} at 1 bar, $(1.90 \pm 0.05) \times 10^{-5}$ cm^2 sec^{-1} at 400 bar, and $(1.77 \pm 0.05) \times 10^{-5}$ cm^2 sec^{-1} at 800 bar. The activation volume for the self-diffusion of ^{22}Na in $NaNO_3$ is 10.7 ± 1.4 cm^3 mole^{-1}. (auth)

29662 METAL MICROSCOPE AND DEWAR SYSTEM FOR FIELD EMISSION STUDIES. William R. Savage and Frank J. Low (Texas Instruments Inc., Dallas). Rev. Sci. Instr., 35: 848-50(July 1964).

The research space of an experimental model of a metal Dewar system was adapted for field emission microscopy. The contamination time of a tungsten field emission cathode was used to estimate the residual gas pressure in the research space when the Dewar was filled with liquid helium with an upper limit for condensable gases of 10^{-13} torr. Field emission patterns were obtained for niobium and niobium-zirconium (25%) alloy as examples of the application of the system to field emission microscopy. (auth)

29663 SIMPLE GLASS ^3He CRYOSTAT FOR ESR AND NMR. J. A. Cowen, R. D. Spence, H. Van Till, and H. Weinstock (Michigan State Univ., East Lansing). Rev. Sci. Instr., 35: 914-15(July 1964).

A ^3He cryostat system that can be used for both ESR and NMR measurements on single crystals in the temperature range 0.3–1.0°K is described. (C.E.S.)

29664 THERMODYNAMIC PROPERTIES OF URANIUM COMPOUNDS. PART I. LOW-TEMPERATURE HEAT CAPACITY AND ENTROPY OF THREE URANIUM CARBIDES. R. J. L. Andon (National Chemical Lab., Teddington, Middx., Eng.), J. F. Counsell, J. F. Martin, and H. J. Hedger. Trans. Faraday Soc., 60: 1030-7 (June 1964).

The heat capacities from 11 to 330°K of samples of uranium monocarbide, uranium sesquicarbide, and uranium dicarbide were measured in an adiabatic calorimeter. Thermodynamic properties for UC, U_2C_3, and $UC_{1.91}$ were calculated from 10 to 330°K and are compared with published data on these compounds. (auth)

29665 ACTIVATION OF HYDROGEN BY POLY COPPER PHTHALOCYANINE. G. J. K. Acres and D. D. Eley (Univ. of Nottingham, Eng.). Trans. Faraday Soc., 60: 1157-69(June 1964).

The catalytic reactions $pH_2 \rightarrow oH_2$ and $H_2 + D_2 \rightarrow 2HD$ were studied on two samples of polymerized copper phthalocyanine, poly CuPC 1 and 2 (sample 2 of higher molecular weight), and monomeric copper phthalocyanine, CuPC. The exchange of atoms between D_2 and the solid and electron spin resonance (esr) absorption spectra was also studied. The effect of hydrogen chemisorbed at high temperature on the esr spectra and catalytic action also proved useful in distinguishing mechanisms and sites. Three temperature ranges were distinguishable: (a) 77 to 200°K, (b) 200 to 373°K, and (c) >373°K. There was a paramagnetic pH_2 conversion with negative temperature coefficient occurring in range (a) on paramagnetic Cu atoms and free electrons in the carbon skeleton (probably σ electrons). Over range (b) paramagnetic (pH_2) and chemical (pH_2, $H_2 + D_2$) activation processes occurred with zero overall apparent activation energy. Over range (c) chemical activation processes occurred with activation energies of about 10 kcal mole^{-1}, probably of activated π-electrons in the polymerized conjugated carbon skeleton, since this activity was most marked in poly CuPC 2. The D_2 exchange with the three solids took place at 523°K with an activation energy of 23 kcal mole^{-1} and an order of one-half. The rate-limiting process is probably the diffusion of H atoms through the crystal. (auth)

29666 NEUTRON AND OPTICAL SPECTRA AS SOURCES OF INFORMATION ON THE MOTION OF MOLECULES IN LIQUIDS. L. I. Komarov and I. Z. Fisher (Minsk Belorussian State Univ., USSR). Ukr. Fiz. Zh., 9: 349-54(1964). (In Ukrainian)

The application of the formalism of Van Hove's time molecular distribution functions to the description of the kinetic properties of condensed systems is considered. The possibilities of obtaining information about these functions from experimental data are studied. It is shown that the Rayleigh light scattering spectrum can be used to determine the asymptotic properties of Van Hove's functions. The characteristics of the spectrum of neutrons scattered in liquids are considered in detail, taking into account the existence of the boundaries of the spectrum of elastic oscillations in the liquids. (auth)

29667 ON THE PROPERTIES OF TaS_3, $TaSe_3$, AND $TaTe_4$. Einar Bjerkelund and Arne Kjekshus (Universitetet, Oslo). Z. Anorg. Allgem. Chem., 328: 235-42(Apr. 1964).

The properties of TaS_3, $TaSe_3$, and $TaTe_4$ were studied by means of x-ray diffraction, density, and magnetic susceptibility measurements. TaS_3 crystallizes orthorhombic with a = 36.804, b = 15.173, and c = 3.340 Å. The pycnometric density was 5.959 g cm^{-3} at 25°C. There are 24 formula units per unit cell and the most probable space group is $C222_1$. $TaSe_3$ crystallizes monoclinic with a = 10.411, b = 3.494, and c = 9.836 Å and β = 106.36°. The pycnometric density was 7.913 g cm^{-3} at 25°C. There are 4 formula units per unit cell and the probable space group is $P2_1$ or $P2_1/m$. $TaTe_4$ crystallizes tetragonal with a = 2×6.514 and c = 3×6.809 Å and c/a = $3/2 \times 1.045$. The pycnometric density was 7.901 g cm^{-3} at 25°C. There are 12×2 formula units per unit cell and the probable space group is P4cc or P4/mcc. The compounds have diamagnetic susceptibilities. (auth)

29668 CHEMISORPTION OF NITROGEN ON EVAPORATED ZIRCONIUM FILMS. Noerbert Hansen (Philips Zentrallaboratorium GmbH, Aachen). Z. Anorg. Allgem. Chem., 329: 68-71(May 1964). (In German)

Changes in electrical resistance and Hall effect during chemisorption of nitrogen on evaporated zirconium films were similar to the effects during chemisorption of carbon monoxide on zirconium. This behavior was consistent with the assumption, that the effective thickness of the metallic layer decreases during chemisorption. (auth)

29669 ON A BLUE ZIRCONIUM NITRIDE. R. Juza, A. Gabel, H. Rabenau, and W. Klose (Christian-Albrechts

Universität, Kiel). Z. Anorg. Allgem. Chem., 329: 136-45 (May 1964). (In German)

By ammonolysis of zirconium tetraiodide at 750°C and of zirconium tetrabromide and chloride at slightly higher temperatures, a zirconium nitride of dark blue color and a composition Zr_xN with $0.940 > x > 0.812$ was obtained. The amount of Zr^{3+} was determined analytically. At stronger heating the samples turned into metallic ZrN. The nitride crystallized with the sodium chloride structure with the zirconium sublattice only partly occupied. The lattice constants lay within the investigated range between 4,566 and 4,550 Å. The specific electric conductivity of Zr_xN was about $3 \times 10^{-2}\ \Omega^{-1}\ cm^{-1}$. The magnetic susceptibility of the samples was about -0.1×10^{-6}. (auth)

29670 DETERMINATION OF THE ACTIVITY COEFFICIENT OF URANYL NITRATE IN DILUTE AQUEOUS SOLUTIONS BY THE EXTRACTION METHOD. V. A. Mikhailov and V. G. Torgov. Zh. Fiz. Khim., 38: 280-6 (Feb. 1964). (In Russian)

Activity coefficients of uranyl nitrate in dilute aqueous solutions and 0.1 M solutions of tributyl phosphate in benzene and carbon tetrachloride were investigated. A method of calculating $\gamma_\pm$ was developed. Values of $\gamma_\pm$ were tabulated for $UO_2(NO_3)_2$ concentrations ranging from 0.01 to 0.2 M. For M = 0.1 and higher the values for $\gamma_\pm$ coincide with those found by the isopiestic method of R. A. Robinson and R. H. Stokes, (Electrolyte Solutions, London, 1959). The activity coefficients of uranyl nitrate in 0.1024 N HNO_3 were also determined. The merits of the extraction method for determining the activity coefficients of electrolytes were discussed. (auth)

29671 RECRYSTALLIZATION OF URANIUM PURIFIED BY PROGRESSIVE SOLIDIFICATION UNDER HIGH VACUUM. Pierre Poeydomenge (Ecole des Mines, Paris), Georges Cizeron, and Paul Lacombe. p.61-7 of "6e Colloque de Métallurgie. Relations Entre Défauts a l'Échelle Atomique et Propriétés Macroscopiques." Gif-sur-Yvette, France, Centre d'Études Nucléaires de Saclay and Paris, Presses Universitaires de France, 1962. (In French)

Work was started to determine the degree of purification that can be obtained by normal freezing of an uranium bath. Electrolytically produced uranium ingots were melted under vacuum in a horizontal elongated boat made of UO_2. After thoroughly degassing the bath, the solidification front was caused to progress slowly from one end of the boat to the other as to obtain a localization of the impurities according to Pfann's law. Different experimental methods led to the conclusion that the first part of the solidified metal is far purer than the further extremity of the ingot. Testing of this metal showed that its behavior is quite different from that with accepted nuclear purity. (auth)

29672 PREPARATION AND PROPERTIES OF CHLORINE-GRAPHITE. Robert Juza and Hinrich Seidel (Christian-Albrechts-Universitat, Kiel). 14p. (CONF-73-25)

From 6th Biennial Conference on Carbon, Pittsburgh, June 1963.

By the intercalation of chlorine at −78°C the anomalous diamagnetism of graphite was reduced from $-9.08 \cdot 10^{-6}$ to $-0.43 \cdot 10^{-6}$. The velocity of formation and decomposition of chlorine–graphite depends on the grain size of the graphite samples and is essentially increased by using graphite residue compounds as starting material. By means of tensimetric analysis the composition of chlorine–graphite was determined as $C_{8.5}Cl$. X-ray studies indicated an intercalation of chlorine into every second interstice of the graphite lattice connected with an enlargement of the lattice constant c by 50.5%. (P.C.H.)

29673 NON-STOICHIOMETRY IN REFRACTORY COMPOUNDS. Michael Hoch (Univ. of Cincinnati). 37p. (CONF-45-4)

From American Ceramic Society Basic Science Divison Meeting, Washington, D. C., Oct. 1963.

Deviation from stoichiometry is related to the various pairwise interaction energies Eij between atoms (or vacancies). The values of Eij control the homogeneity range of a phase: Eij close to zero favors a wide homogeneity range whereas $Eij \gg 0$ and $Eij \ll 0$ are indicative of a narrow homogeneity range. The values of Eij were derived from the variation of the partial free energy of one component with composition. Numerical evaluations were carried out for FeO, MnO, CoO, HfN, and ZrN. The deviation from stoichiometry in UO_{2+x} and CeO_{2-x} is discussed in detail. (auth)

29674 THE SLOW COMPONENT OF SCINTILLATION IN STILBENE. G. Walter, G. Laustriat, and A. Coche (Centre de Recherches Nucleaires, Strasbourg). 14p. (CONF-182-23)

From the 9th Scintillation and Semiconductor Counter Symposium, Washington, D. C., Feb. 1964.

The influence of different factors, such as energy and specific energy loss of incident particle and temperature, on the emission of a stilbene monocrystal was investigated. The experiments can be explained on the basis of triplet-triplet interaction, which could account for the emission of slow fluorescence and also for the slow component of scintillation. The singlet-triplet transition does not seem to play a noticeable part among the processes of formation of triplet excited states. Therefore, it is assumed that the excitation of these levels is mainly resulting from the recombination of ions and low energy secondary electrons. It was also concluded that the initial number of excited molecules in triplet state per unit path length is not proportional to dE/dx since the slow emission intensity is reduced for particles with a high specific energy loss. (P.C.H.)

29675 COATINGS DEPOSITED FROM FUSED SALT BATHS. Janez Zupan (Pfaudler Co., Rochester, N. Y.). 15p. (CONF-492-7)

From National Association of Corrosion Engineers, Chicago, Mar. 1964.

Chromium and modified chromium coatings and titanium coatings were applied in several known coating systems for niobium alloys. Studies made on the deposition of chromium and titanium on Nb-5Zr alloy specimens from fused salt baths are described. A sodium chloride bath containing Na_2SiF_6 and chromium, silicon, and tungsten metal powders appeared to be most suitable for the deposition of chromium. Titanium was deposited from Ti-I_2-NaCl baths. The effect of iodine addition and purity of titanium powder on the thickness of the deposited titanium is investigated. Earlier work on titanium coatings on mild steel is also included. (auth)

Organic Chemistry

29676 PROTON CHEMICAL SHIFTS AND ELECTRON DENSITIES. B. P. Dailey, Albert Gawer, and W. C. Neikam (Columbia Univ., New York). Discussions Faraday Soc., No. 34, 18-24(1962).

The empirical relation between the observed chemical shifts and the electron densities was investigated by examining experimental and theoretical observations for aromatic hydrocarbon ions, azulene, nitrogen heterocycles, substituted benzenes, and cyclohexyl and cyclopropyl derivatives. Corrections to the shifts for ring current and solvent effects were considered, together with other contributions to the shifts. (D.C.W.)

29677 VALENCE BOND STUDIES OF INTERNUCLEAR COUPLING. H. S. Gutowsky and Cynthia Juan (Univ. of Illinois, Urbana). Discussions Faraday Soc., No. 34, 52-63(1962).

Two studies are reported which involve valence bond calculations of internuclear coupling. The first, of the proton spectra for the CH_2CH_2 bridges in (2, 2) metacyclophane, shows conclusively that the relative signs of the geminal and vicinal proton coupling constants are opposite, which disagrees with the theoretical prediction that both are positive. In this compound, the $C-CH_2-CH_2-C$ groups are locked in position with the dihedral angle between alkyl C−C−C bonds slightly less than the symmetrical, staggered 60°. A complete analysis of the A_2X_2 and A_2B_2 type proton spectra, at 60 and 15 Mc/sec leads to the following assignments: $J_t^{HH} = 112.3$, J_g^{HH} (the coupling of the "central" pair of gauche protons) $= \pm 3.2$, $J_{gem}^{HH} = \mp 12.0$, and $J_g^{HH} = \pm 4.0$, all ± 0.1 c/sec. A second related study is concerned with an interpretation for the additivity of substituent contributions to the $^{13}C-H$ coupling constant. Each atom or group X is assigned a characteristic "affinity" for s character in the carbon hybrid orbital of the C−X bond. The additivity can be derived if the s character is distributed among the four carbon orbitals in accord with the relative s affinities of the four substituents, provided that the total s character is conserved. The valence bond approach used with this model gives a linear relation between the s character of the carbon hybrid orbital involved in a C−H bond and the observed $^{13}C-H$ coupling constant ($J_{CH} = 500\ \alpha_H^2$). (auth)

29678 RELATIVE SIGNS OF FLUORINE N.M.R. SPIN COUPLING CONSTANTS BY DOUBLE IRRADIATION. D. F. Evans (Imperial Coll. of Science and Tech., London). Discussions Faraday Soc., No. 34, 139-42(1962).

The relative signs of fluorine constants in a number of saturated fluorocarbons were determined by double irradiation. In all cases, J_{vic}^{FF} is of opposite sign to both J_{gem}^{FF} and $J_{1,3}^{FF}$. (auth)

29679 N.M.R. STUDY OF PROTON EXCHANGE OF WEAK BASES IN HYDROGEN FLUORIDE. C. MacLean and E. L. Mackor (Koninklijke/Shell-Laboratorium, Amsterdam). Discussions Faraday Soc., No. 34, 165-76(1962).

The proton exchange of proton complexes of substituted benzenes was studied by NMR (40 and 60 Mc/sec) in hydrogen fluoride between −105 and +50°C. The added proton may exchange intramolecularly in hexamethylbenzene and durene, or it may transfer to the aromatic molecule or the solvent in an intermolecular reaction. Considerable activation energies (8 kcal/mole) are involved in all transfers of the added proton from the CH_2 or $CH \cdot CH_3$ group in the proton complex. This high energy may be related to the weakness of the interaction of the aliphatic CH_2 group with the polar solvent. Proton exchange of H_3O^+ and HF_2^- ions in HF is very rapid and nearly independent of temperature. (auth)

29680 PYROLYTIC STABILITY OF SOME BORO-ORGANIC COMPOUNDS. G. Necetti, G. Nardini, and S. Zanelli (Università, Pisa). Energia Nucl. (Milan), 11: 248-57(May 1964). (In Italian)

The results of experimental research on high-temperature stability of some aromatic boroörganic compounds are reported. The study is a preliminary investigation to decide which of these compounds can be selected for a further research on the possibility of use as soluble poisons for nuclear reactors moderated and cooled with organic fluids. The investigated compounds are benzene and naphtheneboronic anhydrides, esters of benzeneboronic and boric acids, triphenyl and trinaphthylboron. Pyrolytic tests were performed on both pure compounds and their solutions in organic fluids (O.M.P. mixture) at 300 to 450°C, for different exposure times. (auth)

29681 PREPARATION OF MARKED MOLECULES BY BIOSYNTHESIS. Walter G. Verly (Universite, Liège). Euratom Bull., No. 2, 21-5(June 1964).

Methods of labeling organic compounds by biosynthesis are discussed. Examples are presented. (M.C.G.)

29682 THE QUENCHING OF CARBON-14 AND TRITIUM BY ORGANIC SOLVENTS IN TWO COMMON LIQUID SCINTILLATION SOLUTIONS. I. L. Shapiro and D. Kritchevsky (Wistar Inst. of Anatomy and Biology, Philadelphia). Intern. J. Appl. Radiation Isotopes, 15: 325-30(June 1964).

The quenching effects exerted on two liquid scintillation solutions, toulene-PPO-dimethyl POPOP and Bray's solution, by various organic solvents (H_3PO_4-p-dioxane, 1:99 methanol, ethanol, hyamine, acetic acid, pyridine, acetic anhydride−pyridine 1:1, and chloroform) were studied. In the toluene system, it was found that the $^{14}C/^3H$ counting efficiency for 0 to 5 ml of each of these solvents was approximately constant. The ratios calculated for methanol, ethanol, hyamine, and H_3PO_4-p-dioxane were closely similar and averaged 1.74, while the ratios for acetic acid, acetic anhydride, pyridine, and acetic anhydride−pyridine (1:1) fell into a second group and averaged 2.23. One halogenated hydrocarbon, chloroform, was found to have a higher quenching ratio, 2.78. Calculations using representative solvents from each of these groups of quenchers (ethanol and acetic acid) demonstrated the potential utility of this factor in predicting counting efficiencies (in the toluene system) for one isotope (^3H) when that of another (^{14}C) is known. Quenching curves for ^{14}C and ^3H with Bray's solution also are described. (auth)

29683 MECHANICALLY INDUCED MOLECULAR REORIENTATION IN MULTIMOLECULAR FILMS. L. S. Bartell and C. L. Sutula (Ames Lab., Ames, Iowa). J. Phys. Chem., 67: 2413-16(1963). (IS-651)

Multimolecular films of a variety of long-chain hydrocarbons and hydrocarbon derivatives were subjected to the shearing action of rubbing with soft tissue paper. If the effective total chain length (monomers of most substances, dimers of acids) exceeded 25−30 carbon atoms, the molecules were found by electron diffraction to fall over with their horizontal component parallel to the direction of rubbing. The molecular axes pointed upward against the direction of rubbing, forming an angle of several degrees with the plane of the surface. The angle was larger for orthorhombic packing than monoclinic, larger for short chains than for long. Chains shorter than the critical length were observed to disorder instead of reorienting regularly. Impurities often, but not always, interfered seriously with reorientation. The mechanism of the reorientation process is discussed. Measurements also were made of the rate of evaporation of the films as a function

of chain length. It was found that molecules shorter than the critical length for reorienting were significantly more volatile than molecules exhibiting reorientation. Accordingly, the possibility is not ruled out that surface layers of molecules below the critical length are reoriented by shear but lost by evaporation into the vacuum chamber of the electron diffraction unit. For chains just under the critical length the thickness of such a superficial layer appears to be no greater than a molecular length. (auth)

29684 PROTON MAGNETIC RESONANCE SPECTRA OF AMMINE AND ETHYLENEDIAMINE COBALT COMPLEXES IN HEAVY WATER. Shoichi Hayashi (Tokyo Univ.). Nippon Kagaku Zasshi, 85: 256-8(Apr. 1964). (In Japanese)

The proton resonance spectra of four cobalt ammines dissolved in heavy water were measured at a frequency of 27 MC at 23°C. A single broad line assigned to the NH_2 protons of ligands for trans-$[Coen_2Cl_2]Cl$ solution was observed for a few hours at the field lower than that for the sharp line due to the HDO. The CH_2 line appears at the highest field, and it was considerably lower than that for cis-$[Coen_2Cl_2]Cl$ solution. A single sharp line was observed for $[Co(NH_3)_6]Cl_3$, $[Co(NH_3)_6]\cdot(NO_3)_3$ and cis-$[Coen_2Cl_2]Cl$ solution in the position corresponding to the HDO line, and the intensities of these signals were approximately proportional to the N–H proton contents. It was confirmed that the characteristic time of half life of the proton exchange between the ligands and solvent water for $[Co(NH_3)_6]^{3+}$ are of the order of minutes at room temperature and that the proton exchange rate for the cis-isomer is larger than that for the trans-isomer. (auth)

29685 NITROSYLRUTHENIUM-ORGANOPHOSPHORUS COMPLEXES. Richard M. Wallace (E. I. du Pont de Nemours and Co., Aiken, S. C.). Nucl. Sci. Eng., 19: 296-9(July 1964). (TID-18818)

Nitrosylruthenium-dibutylphosphate complexes were prepared by the reaction of trinitrato-nitrosylruthenium with dibutylphosphoric acid and by the reaction of nitrosylruthenium hydroxide with dibutylphosphate in alkaline solutions. The products are mixtures of compounds of indefinite composition, some of which are monomeric and others polymeric. Complexes were also prepared by the reaction of trinitrato-nitrosylruthenium with monobutylphosphoric acid and dinitronitrosylruthenium with dibutylphosphoric acid. (auth)

29686 ISOTOPE EFFECT IN HYDROCARBON FLAME BANDS (DEUTERIUM SUBSTITUTION). W. M. Vaidya (National Physical Lab., New Delhi, India). Proc. Roy. Soc. (London), Ser. A, 279: 572-81(June 16, 1964).

By suitably modifying the apparatus for the production of the acetylene glow with atomic oxygen, a large number of deutero-hydrocarbon flame bands were obtained in the spectrum and it was possible to complete the analysis of the isotopic bands. These bands were arranged into v′, v″ arrays belonging to four groups. It was shown that the first group of the isotopic system corresponds to the A group of ordinary hydrocarbon flame bands, while the bands in the second group are due to the CD stretching frequency and those in groups III and IV are due to the bending frequency. The problem of the emitter was discussed, and the evidence is strongly in favor of HCO. (auth)

29687 PREPARATION OF ^{32}P-2,3-DIPHOSPHOGLYCERIC ACID LABELED AT A SINGLE POSITION AND ITS APPLICATION TO A STUDY ON DIPHOSPHOGLYCERATE PHOSPHATASE. Takashi Hashimoto, Teiko Takahashi, and Haruhisa Yoshikawa (Tokyo Univ.). Radioisotopes (Tokyo), 13: 213-16(May 1964).

^{32}P-Diphosphoglyceric acid labeled at a single position was prepared. For labeling at C-2 3-phosphoglyceric acid and ^{32}P-phosphoric acid were treated with dicyclohexylcarbodiimide in pyridine and the synthesized ^{32}P-2,3-diphosphoglyceric acid isolated by column chromatography. ^{32}P-3-Phosphoglyceric acid labeled at C-3 was prepared by yeast fermentation and esterified with non-radioactive phosphoric acid by the same method as labeling at C-2. Two kinds of the labeled diphosphate were subjected to hydrolysis by diphosphoglycerate phosphatase prepared from rabbit muscle. The results revealed that the liberated phosphate comes almost exclusively from C-2 position but not from C-3 position. When hemolysate was incubated with added inosine and ^{32}P-phosphoric acid the radioactivity was incorporated into 2,3-diphosphoglyceric acid. Diphosphoglycerate phosphatase was employed to determine the distribution of ^{32}P. The isotope was shown to be evenly distributed between both of the phosphate groups. This can be explained by that both originate from a common inorganic phosphate pool. (auth)

29688 KINETICS OF HYDROGEN ABSTRACTION FROM HYDRAZINE, AMMONIA AND TRIDEUTEROAMMONIA. Peter Gray and J. C. J. Thynne (Univ. of Leeds, Eng.). Trans. Faraday Soc., 60: 1047-52(June 1964).

The reactions of methyl radicals with ammonia, trideuteroammonia, and hydrazine were investigated in order to determine the rate of hydrogen-atom abstraction. Over the temperature range (110 to 180°C) studied, the rate of hydrogen abstraction from hydrazine was much greater than from ammonia (by about 500 times at 140°C). This result was in accord with qualitative knowledge of the relative reactivity of hydrazine and ammonia and favors a value of the N–H bond dissociation energy in hydrazine considerably lower than that in NH_3. Arrhenius parameters (based on Shepp's value of $10^{13.34}$ cm^3 $mole^{-1}$ sec^{-1} for the combination of methyl radicals) are given. Substitution of D for H in ammonia changed the reactivity to an extent expected from zero-point-energy differences for the stretching of one bond. Ammonia and hydrazine were compared with methane and ethane, and methylamine was compared with both pairs. (auth)

29689 DECOMPOSITION OF ACETYLENE ON INCANDESCENT NIOBIUM. P. H. Dawson and A. J. B. Robertson (King's Coll., London). Trans. Faraday Soc., 60: 1122-30(June 1964).

The decomposition of acetylene was investigated on niobium filaments at pressures between 5×10^{-6} and 1×10^{-4} mm Hg. The probability P of reaction at a collision of C_2H_2 with the surface was given by $P = B \exp(-E/RT)$. Complete breakdown of C_2H_2 occurred causing deposition of C on the catalyst. The state of the catalyst surface was dependent on the past use of the catalyst, particularly its immediate pre-treatment, and states of widely different degrees of carburization, and the transitions from one state to another, were studied. Well-outgassed filaments showed great catalytic activity with P nearly unity at 850°C. A decline in activity occurred with use at lower temperatures and seemed to be related to carburization. On slightly carburized filaments the activation energy for P was 36 kcal/mole and B varied with carburization from $10^{3.8}$ to $10^{6.1}$. With carburization sufficient to form Nb_2C, the characteristics of the reaction changed: B became constant at $10^{3.3}$ with E of 77 kcal/mole. These filaments could also be made more active by a short high-temperature flashing, but the extra

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activity decayed as reaction occurred. At high temperatures P became unity on the slightly carburized filaments. Between P = 1 and P = 0.1 the Arrhenius relation failed, but the results could be interpreted quantitatively by a simple equation based on the idea of a molecular adsorption prior to reaction. (auth)

29690 THEORY OF SEQUENTIAL PROCESSES AND THE CRYSTALLIZATION OF HIGH POLYMERS. F. C. Frank and M. P. Tosi (Univ. of Bristol, Eng.). p.936-42 of "Radiation Damage in Solids." New York, Academic Press, 1962.

A nucleation theory of the crystallization of high polymers is outlined, in which the nucleation process is treated as a sequential process. (D.C.W.)

Radiation Chemistry and Radiochemistry

Refer also to abstracts 30073, 30248, and 30988.

29691 (BNL-8056) THE CHEMONUCLEAR AND RADIATION CHEMICAL PROCESS DEVELOPMENT PROGRAM AT BROOKHAVEN NATIONAL LABORATORY. Meyer Steinberg and Bernard Manowitz (Brookhaven National Lab., Upton, N. Y.). Apr. 1964. Contract AT-30-2-GEN-16. 37p. (CONF-558-1)

From Radiation Processing Symposium, Buffalo, N. Y., May 1964.

The various ways in which nuclear energy can be used in the chemical process industry are reviewed: radiochemonuclear, thermonuclear, electrochemonuclear, and photochemonuclear. The research program is mostly concerned with radiochemonuclear processes using fission fragments, neutrons, gamma rays, and isotopes. The inpile static capsule experiments for studying the fission fragment energy deposition efficiency of various thin fuel elements are described and some results given. An inpile chemonuclear loop facility for use in the Brookhaven Graphite Research Reactor and the fabrication of thin fuel elements are described. An extensive investigation was made of the homopolymerization of ethylene and its copolymerization with a large number of monomers by ^{60}Co gamma rays. The design of a high-pressure gamma loop facility for the polymerization of ethylene and other radioinduced process systems is described. (D.L.C.)

29692 (DP-654) ALPHA-PARTICLE RADIOLYSIS OF ANION EXCHANGE RESINS. Rolland W. Ahrens (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Nov. 1961. Contract AT(07-2)-1. 22p.

Irradiation of "Dowex" 1, "Permutit" S-1, and "Permutit" SK anion exchange resins with alpha particles results in losses in ion exchange capacity and in "apparent per cent crosslinkage." The order of decreasing radiolytic stability for these properties is "Permutit" SK > "Permutit" S-1 > "Dowex" 1. (auth)

29693 (HW-67241) RADIATION-INDUCED GAS–GRAPHITE REACTIONS IN SEALED CAPSULES. PART I. CARBON MONOXIDE AND CARBON DIOXIDE. B. A. Ryan (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 20, 1963. Contract AT(45-1)-1350. 32p.

Irradiations of gases in sealed quartz capsules were conducted in a Hanford Reactor at about 550°C over a range of pressures. Changes in gas composition and graphite weight were measured, and the nature of deposited materials was examined. The radiation-induced disproportionation of CO was measured in the pressure range 1.5 to 18 atm. The loss of CO was accompanied by the formation of CO_2 and black solids, which were deposited uniformly on the walls of the container. The yield of CO_2 was dependent upon the CO pressure. Electron micrographs of the deposits showed two distinct structures: one was similar to carbon black and one is believed to be polymerized carbon suboxide. The radiation-induced reaction between graphite and CO_2 was measured at about 550°C in the pressure range 1.5 to 45 atm. Both graphite and CO_2 were consumed, resulting in the formation of CO. The ratio of the number of moles of CO_2 reacted to moles of CO formed was 0.86, in contrast to the value of 0.5 which would have been observed if the familiar reaction, $C + CO_2 = 2CO$, were the only one occurring. In the pressure range 1.5 to 61 atm and the temperature range 360 to 675°C there was negligible thermally activated reaction between graphite and CO_2. At the higher temperatures trace amounts of CO were measured, however. The reaction was probably inhibited by CO, since the reaction is expected to be measurable in a flowing system where no CO accumulates. In the temperature range from 1200 to 1400°C and the pressure range 17 to 19 atm the rate of reaction with CO_2 was rapid, and the reaction product was CO. The stoichiometry corresponded to the familiar equation, $C + CO_2 = 2CO$. (auth)

29694 (IA-913) RAPID SEPARATION AND HOT ATOM CHEMISTRY OF NITROGEN ISOTOPES. S. Amiel and E. Yellin (Israel. Atomic Energy Commission. Soreq Research Establishment, Rehovoth). Jan. 1964. 11p.

Short-lived nitrogen-16 produced by the reaction of reactor neutrons with oxygen in a circulating loop, was separated and obtained as a steady source by continuous condensation at low temperatures. The time elapsing between the formation of the nitrogen and its separation and counting was less than one second. The hot atom chemistry of nitrogen in the oxygen gas medium was studied and the formation of NO was found to be predominant. It was concluded that the oxide formation takes place with the recoiling nitrogen before its thermalization. (auth)

29695 (UJV-734/62) CONDENSED MATTER IRRADIATED WITH IONIZING RADIATIONS. Jaroslav Bednar (Československá Akademie Věd. Ústav Jaderného Výzkumu, Rež). [1962]. 20p.

A qualitative model of condensed matter irradiated with ionizing radiation is given. It is based on the assumption that the absorbed energy is initially delocalized over a volume appreciably greater than the volume of a single molecule. The absorbed energy localizes in a time shorter than one molecular vibration of the medium. The localization brings about predominantly formation of superexcited states, since in most cases the energy deposited in primary events is greater than the ionization energy of the medium. Several basic parameters are introduced that make possible a more exact treatment of irradiated condensed matter. It is shown that a number of particular effects in radiolysis of water or organic liquids conform to the proposed model. (auth)

29696 (AEC-tr-6231) ANNUAL REPORT OF THE JAPANESE ASSOCIATION FOR RADIATION RESEARCH IN POLYMERS, VOLUME I, 1958–59. Translation of Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 1: 1958-59. 573p.

Research studies in the field of radiation chemistry of polymers are summarized for work accomplished in Japan from May 1958 to March 1960. Summaries are included for work accomplished at Osaka and Tokyo Institutes. Also, 83 papers are included of work accomplished at the

Institutes. Separate abstracts were prepared for 70 of the papers. One of the others was abstracted previously (see NSA 16: 22181). (D.L.C.)

For abstracts of individual papers see: 29697, 29698, 29699, 29700, 29701, 29702, 29703, 29704, 29705, 29706, 29707, 29708, 29709, 29710, 29711, 29712, 29713, 29714, 29715, 29716, 29717, 29718, 29719, 29720, 29721, 29722, 29723, 29724, 29725, 29726, 29727, 29728, 29729, 29730, 29731, 29732, 29733, 29734, 29735, 29736, 29737, 29738, 29739 29740, 29741, 29742, 29743, 29744, 29745, 29746, 29747, 29748, 29749, 29750, 29751, 29752, 29753, 29754, 29755, 29828, 30241, 30242, 30243, 30244, 30317, 30318, 30352, 30353, 30937, and 30938.

29697 (AEC-tr-6231(p.79-90)) GRAFT POLYMERIZATION TO CELLULOSE (PULP) BY PRE-IRRADIATION. H. Yorita and Y. Nakai. (Translation)

The graft polymerization of methyl methacrylate and styrene on cellulose pulp was studied using pre-irradiation of the pulp by a ^{60}Co source and a Van de Graaff accelerator. The effects of solvent-to-monomer ratio, water, Fe^{2+}, and temperature on the polymerization were studied for methyl methacrylate. The effects of preliminary thermal treatment of methyl methacrylate and styrene were also studied. ESR studies show that peroxide radicals are produced and that the frozen radicals left after thermal treatment participate in graft polymerization for methyl methacrylate but not for styrene. The degree of swelling of the grafts is shown to be improved over that of the ungrafted original. (D.L.C.)

29698 (AEC-tr-6231(p.91-101)) RADIATION-INDUCED GRAFT POLYMERIZATION TO POLYVINYL ALCOHOL. (Translation)

The graft polymerization of styrene, methyl methacrylate, and other monomers on polyvinyl alcohol was studied using simultaneous gamma irradiation under immersion. For styrene and methyl methacrylate, no grafting occurred unless water was present. The effects of water were not so pronounced for acrylonitrile, vinyl acetate, 2-vinyl pyridine, acryloamide, and acrylates. The effects of air, temperature, heating, and iron salts were studied for methyl methacrylate, using preirradiation. Heating of styrene was also studied. (D.L.C.)

29699 (AEC-tr-6231(p.102-4)) GRAFT POLYMERIZATION TO CELLULOSE INDUCED BY RADIATION. (Translation)

In a preliminary experiment, water was found to have an accelerating effect on the graft polymerization of methyl methacrylate (MMA) on cellulose. The graft polymerization of MMA on rayon was carried out using immersion-simultaneous irradiation in air. Styrene was also grafted onto rayon by preirradiation in the presence of water. (D.L.C.)

29700 (AEC-tr-6231(p.105-11)) RESEARCH ON GRAFT POLYMERIZATION TO COTTON. (Translation)

Experiments on graft polymerization of styrene to cotton were carried out in an attempt to improve the properties of cotton. Pre-irradiation in air with an electron beam was used. The effects of temperature, thermal treatment, and ferric ions were studied. The effects of various alcohols, acetone, and benzene as solvent were determined for both systems with and without water. The influence of air and water is discussed. The graft polymerization of styrene to dyed cotton was studied for many dyes; decoloration of the dyes was rare, but most of the dyes decreased the graft rate. (D.L.C.)

29701 (AEC-tr-6231(p.112-13)) GRAFT POLYMERIZATION TO NYLON 6 INDUCED BY RADIATION. S. Torikai. (Translation)

Graft polymerization of styrene to nylon 6 films was carried out using simultaneous gamma irradiation in air. The effects of ambient gases, dose rate, and solvents were studied. Graft polymerization of divinyl benzene to nylon was also studied briefly. (D.L.C.)

29702 (AEC-tr-6231(p.114-18)) GRAFT POLYMERIZATION TO POLYPROPYLENE BY PRE-IRRADIATION IN AIR. Y. Akiyama. (Translation)

Graft polymerizations were carried out on polypropylene fibers which were pre-irradiated in air with gamma rays. The effects of metallic salts (ferrous and ferric sulfates, cerous and ceric nitrates, $TiCl_3$, $SnCl_2$, and mercurous and mercuric nitrates) on the graft polymerization of acrylamide were determined. The effects of storage and heating after pre-irradiation were studied for the graft polymerization of methyl methacrylate. (D.L.C.)

29703 (AEC-tr-6231(p.119-20)) RESEARCH ON IRRADIATION OF HIGH POLYMERS WITH HEATING. REPORT 1. GEL FORMATION BY IRRADIATION OF POLYVINYL ALCOHOL WITH HEATING. Preliminary Report. I. Sakurata, K. Okada, and H. Kimura. (Translation)

Experiments are reported which show that gelation appears when PVA is irradiated by gamma rays at 110 and 140°C. Gelation dosages and apparent cross-bridging G values are given. It is concluded that higher irradiation temperatures are preferable for cross-bridging. (D.L.C.)

29704 (AEC-tr-6231(p.121-2)) RESEARCH ON IRRADIATION OF HIGH POLYMERS WITH HEATING. REPORT 2. IRRADIATION OF POLYVINYL ALCOHOL WITH HEATING. K. Abe. (Translation)

The gelation of PVA which was irradiated at 90, 120, 140, and 170°C is reported. Gelation dosages and apparent and true cross-bridging G values are tabulated. The results show that irradiation in air at high temperatures is more favorable for cross-bridging than irradiation under vacuum. The effects of the heating are discussed. (D.L.C.)

29705 (AEC-tr-6231(p.123-4)) RESEARCH ON IRRADIATION OF HIGH POLYMERS WITH HEATING. REPORT 3. IRRADIATION OF POLYVINYL CHLORIDE WITH HEATING AND RADIATION-INDUCED CROSS-BRIDGING OF MONOMER-ADDED POLYVINYL CHLORIDE. N. Seiryo. (Translation)

Gelation of polyvinyl chloride was carried out by irradiation in vacuum at temperatures up to 120°C. Gelation dosages and cross-bridging G values are tabulated. Since coloration begins soon after gelation, ethylene glycol dimethacrylate and triallyl cyanurate additives were tested in conjunction with intermittent irradiation and found to result in gelation at reduced dosages. (D.L.C.)

29706 (AEC-tr-6231(p.125-35)) STUDY OF GAMMA-RAY IRRADIATION EFFECTS ON POLYVINYL ALCOHOL BY INFRARED ABSORPTION SPECTROSCOPY. I. Sakurata, S. Tanaka, and K. Okada. (Translation)

The effects of gamma irradiation in air and vacuum at room temperature and 140°C on PVA film were studied by means of infrared spectroscopy. At room temperature in air, an oxidation reaction occurs with the formation of carbonyl radicals and double C=C bonds and the reduction of hydroxyl radicals, and this effect is increased by

carrying out the irradiation at 140°C. In vacuum, the only irradiation effect observed is a relatively low production of carbonyl radicals. (D.L.C.)

29707 (AEC-tr-6231(p.136-7)) ON GASES EVOLVED DURING THE IRRADIATION OF SOLID POLYVINYL ALCOHOL. S. Oyabu. (Translation)

The gases evolved from PVA films after gamma irradiation in vacuum at room temperature were analyzed by mass spectrometry. The results indicate that only water is evolved. The G value for formation of water decreases with dose, from ~500 at 3.4×10^5 r to ~6 at 2.5×10^8 r. (D.L.C.)

29708 (AEC-tr-6231(p.138-9)) IRRADIATION OF POLYVINYL CHLORIDE IMMERSED IN AMINE GROUP. K. Takebana. (Translation)

The effects of gamma irradiation of PVC immersed in various amines (monoethanol amine, aqueous ammonium, and ethyl amine) were studied with respect to color, mass, viscosity, strength, and degree of elongation. The results indicate the formation of cross-bridging and terminal bonds. (D.L.C.)

29709 (AEC-tr-6231(p.142)) GAMMA-RAY IRRADIATION OF POLYMER MIXTURE. Shigeru Kawase. (Translation)

A mixture of crosslinked polyethylene and decomposed polyisobutylene was irradiated. Changes in the mixture properties compared with those in polyethylene alone, indicate an interaction between the polymers. (D.L.C.)

29710 (AEC-tr-6231(p.143-9)) EXPERIMENTS ON LOW TEMPERATURE RADIATION POLYMERIZATION. Seizou Okamura, Tatsuya Ikegami, Kouichiro Hayashi, and Tadao Natori. (Translation)

Gamma pre-irradiation at −196°C followed by standing at above room temperature to induce polymerization, was investigated for several monomers, and results are reported in some detail for acrylamide and methyl methacrylate. Low-temperature radiation polymerizations of vinyl acetate and vinyl chloride were carried out at −78°C, and the composition of the resulting polymers was studied. (D.L.C.)

29711 (AEC-tr-6231(p.150-4)) LOW-TEMPERATURE RADIATION POLYMERIZATION OF VINYL ACETATE. Seizou Okamura, Kouichiro Hayashi, and Kiyoshi Mori. (Translation)

Polymerizations of vinyl acetate by gamma radiation were carried out at 0, −20, and −78°C in solution and solid state. The temperature dependence of the polymerization velocity and average degree of polymerization were studied. The solvents used in the solution polymerization were methylene chloride, methanol, ether, and toluene. (D.L.C.)

29712 (AEC-tr-6231(p.155-8)) RADIATION AND ULTRAVIOLET-RAY POLYMERIZATION OF FORMALDEHYDE. Seizou Okamura, Kouichiro Hayashi, Yasuzou Nakazio, Shigenori Shiomi, and Mitzuo Arigo. (Translation)

The gamma-induced polymerization of formaldehyde was carried out at −80°C in methylene chloride. Copolymerizations with vinyl monomers and the effects of additives were also studied, and the results indicate that gamma-induced polymerization proceeds by a cationic mechanism. Ultraviolet-induced polymerization was carried out in acetone and methylene chloride with and without additives; the results indicate a free radical mechanism. (D.L.C.)

29713 (AEC-tr-6231(p.159-62)) RADIATION POLYMERIZATION OF STYRENE BY PRE-IRRADIATION. Seizou Okamura, Kouichiro Hayashi, and Masanobu Nishii. (Translation)

Styrene was polymerized by pre-irradiation by an electron beam followed by standing at above room temperature. The formation and reaction of peroxides were studied. The polymerization rate was determined as a function of irradiation dose, and the activation energy was measured to be 1.4 ± 3 kcal/mole. (D.L.C.)

29714 (AEC-tr-6231(p.163-9)) ANIONIC POLYMERIZATION BY RADIATION IN AMINE SOLVENT. Seizou Okamura, Kouichiro Hayashi, Masanobu Nishii, and Yoko Nakamura. (Translation)

Anionic polymerization by gamma irradiation in amine solvents was investigated using principally methyl methacrylate (MMA) in isopropylamine. The effects of radiation dose rate on the polymerization of MMA in isopropylamine were determined at 30 and −78°C. The effects of solvent (methylene chloride, triethylamine, and diethylamine) and additives at −78°C were studied; none of the solvents were as efficient as isopropylamine, and water accelerates the reaction. Polymerization of acrylonitrile in isopropylamine and triethylamine was also studied at 20 and −78°C. The properties of the polymers of MMA formed at 30 and −78°C were determined. (D.L.C.)

29715 (AEC-tr-6231(p.170-4)) SOLVENT EFFECT ON RADIATION POLYMERIZATION OF STYRENE. Seizou Okamura, Kouichiro Hayashi, and Yasuzou Nakazio. (Translation)

The effects of solvents on the gamma-induced polymerization of styrene were studied by means of phosphorescent intensity measurements. Results are expressed as ratio of solution to solid-state polymerization rate as a function of solution composition. The solvents for which results are reported are ethylbenzene, cumene, mesitylene, and anisole. (D.L.C.)

29716 (AEC-tr-6231(p.175-85)) RADIATION POLYMERIZATION OF AQUEOUS SOLUTION OF ACRYLONITRILE IN PRESENCE OF METALLIC IONS. Seizou Okamura, Kouichiro Hayashi, and Akihiro Sakamoto. (Translation)

The effects of the sulfates of Fe(II), Cu, Cd, Co, Ni, Mn, Al, Zn, Mg, and Na and $HgCl_2$ on the gamma-induced polymerization of acrylonitrile in aqueous solution were investigated at 30°C. Both the rate and degree of polymerization were determined. The salts, especially $FeSO_4$ and $CuSO_4$, decrease the rate and degree of polymerization. The $FeSO_4$ effect was investigated in more detail with respect to the variables involved, and it is shown that the Fe^{2+} ion catalyzes the termination step of the polymerization. Cu^{2+} undergoes a similar reaction, and the resulting cuprous ion is stabilized by complexing with acrylonitrile. The relationship of the salt effect with the electromotive series is discussed. (D.L.C.)

29717 (AEC-tr-6231(p.186-90)) DETERMINATION OF RADIATION COPOLYMERIZATION VELOCITY OF METHYL METHACRYLATE-STYRENE SYSTEM. Seizou Okamura, Kouichiro Hayashi, and Tadashi Iwai. (Translation)

Radiation copolymerization velocities and G_R values were determined for the methyl methacrylate–styrene and the methyl isobutyrate–ethylbenzene systems. For the first system, the G_R was additive, indicating no energy transfer to styrene. For the second system, an energy transfer from methyl isobutyrate to ethylbenzene occurs. (D.L.C.)

29718 (AEC-tr-6231(p.191-6)) RADIATION COPOLYMERIZATION OF ISOPROPENYL ACETATE AND VINYL ACETATE. Seizou Okamura, Kouichiro Hayashi, and Kazumasa Kamada. (Translation)

The gamma-induced copolymerization of mixtures of isopropenyl acetate and vinyl acetate was studied at −78, 0, and 30°C. The polymerization velocity, molecular weight, and softening point of the polymer all decreased with increasing isopropenyl acetate fraction in the monomer mixture. The relationship between the mole fraction of isopropenyl acetate in the monomer and that in the polymer was determined. The reason for the negative effect of isopropenyl acetate on the polymerization probably lies in the production of resonance-stabilized radicals. (D.L.C.)

29719 (AEC-tr-6231(p.197-200)) RADIATION COPOLYMERIZATION OF ACRYLONITRILE VINYL CHLORIDE. Seizou Okamura, Kouichiro Kayashi, and Tadao Natori. (Translation)

Radiation copolymerization of vinyl chloride–acrylonitrile mixtures was carried out in solid state and solution (methylene chloride and ethyl chloride) at 30 and −78°C. Polymerization rates and dose rate dependence were determined. The relationship of the vinyl acetate content in polymer to that in the monomer mixture was determined. Some of the properties of the copolymer were studied. (D.L.C.)

29720 (AEC-tr-6231(p.201-4)) RADIATION GRAFT POLYMERIZATION OF CELLULOSE FIBERS. Seizou Okamura, Kouichiro Hayashi, and Yoshio Kobayashi. (Translation)

The gamma-induced graft polymerization of styrene on cellulose fibers was studied. The effects of methanol–styrene ratio and dose rate on the graft polymerization ratio were determined. The probable mechanisms which are operative at different dose rates are discussed. (D.L.C.)

29721 (AEC-tr-6231(p.205-11)) RADIATION GRAFT POLYMERIZATION IN A HOMOGENEOUS SYSTEM. Seizou Okamura, Kouichiro Hayashi, and Yosuhisa Kitanishi. (Translation)

The dynamics of gamma-induced polymerization of methyl methacrylate were studied using polyvinyl acetate (PVAc) and ethyl acetate as solvents. Two kinds of PVAc were used, one with a high degree and the other with a low degree of polymerization. The initial polymerization rate was found to increase with PVAc fraction, especially for the PVAc with the higher degree of polymerization, while for ethyl acetate, it decreases with solvent fraction in a linear manner. At low solvent fractions, the rate is at a minimum at 2.5 mole % PVAc. The dose rate dependence was determined for both PVAc and ethyl acetate. The activation energy for PVAc was determined to be 4.6 kcal/mole. (D.L.C.)

29722 (AEC-tr-6231(p.212-19)) CHANGES IN VISCOSITY OF POLYDIMETHYL-SILOXANE SOLUTION CAUSED BY GAMMA RAY IRRADIATION. Seizou Okamura, Kouichirou Hayashi, and Kenji Daidan. (Translation)

The lowering of viscosity of polydimethylsiloxane with a molecular weight of $\sim 3.6 \times 10^5$ by gamma irradiation at room temperature was studied in several organic solvents and in a siloxane solvent. The results were used to calculate efficiencies for breaking of principal chains for each solvent. (D.L.C.)

29723 (AEC-tr-6231(p.220-4)) HALOGENATION OF POLYMERS BY IRRADIATION. PART 1. CHLORINATION OF POLYSTYRENE BY IRRADIATION. Seizou Okamura, Kouichiro Hayashi, and Masanobu Nishii. (Translation)

The chlorination of polystyrene was carried out using gamma irradiation of CCl_4 solutions of polystyrene and Cl_2. The effects of Cl_2 content and radiation dose on the chlorination were studied. The ratio of displacement to addition reaction is discussed. The properties and structure of the chlorinated polystyrene are described. (D.L.C.)

29724 (AEC-tr-6231(p.225-9)) HALOGENATION OF POLYMERS BY IRRADIATION. PART 2. CHLORINATION OF POLYVINYL ALCOHOL BY IRRADIATION. Seizou Okamura, Kouichiro Hayashi, and Masanobu Nishii. (Translation)

Radioinduced chlorination of PVA was carried out in CCl_4 and $CHCl_3$. The effects of Cl_2 content and temperature on the chlorination were studied. The solubility properties and structure of the chlorinated PVA are described. Chlorine elimination reactions show that the Cl introduced into PVA is easily removed. (D.L.C.)

29725 (AEC-tr-6231(p.230-2)) CHLORINATION OF SILICONES BY IRRADIATION. Seizou Okamura, Kouichiro Hayashi, and Kenji Daidan. (Translation)

Mixtures of dimethylsilicone oil and Cl_2 were gamma-irradiated in air and vacuum. The results for air and vacuum were similar. The maximum degree of chlorination is limited to ~0.6–0.7, indicating dichlorination of the methyl groups. After correction for the dark reaction, the G value at initial irradiations is $\sim 7 \times 10^4$. Solubilities and infrared spectra of the chlorinated oil are compared with those for nonchlorinated oil. (D.L.C.)

29726 (AEC-tr-6231(p.233-8)) CHLORINATION AND SULFONATION OF POLYOLEFINS BY IRRADIATION. Seizou Okamura, Kouichiro Hayashi, Masanobu Hishii, and Yoko Nakamura. (Translation)

Polypropylene and polyethylene fibers and films were chlorinated by gamma irradiation, and the effects on dyeing and mechanical properties are described. It was found that the chlorination occurred in the noncrystalline region of the original fiber. Chlorination of polyethylene was combined with graft copolymerization of several monomers (methyl methacrylate, styrene, vinylpyridine, and vinylpyrrolidone) to give a higher graft effect. Sulfonation of polymers of styrene, ethylene, propylene, methyl methacrylate, and vinyl acetate is also reported. (D.L.C.)

29727 (AEC-tr 6231(p.239-44)) RADIATION OXIDATION OF SILICONES. Seizou Okamura, Kouichiro Hayashi, and Kenji Daidan. (Translation)

Oxygen absorption and peroxide formation rates were determined during the radiation oxidation of polydimethylsiloxane. The relation between the G values of gas absorption and formation and the viscosity is discussed. Graft polymerization of acrylonitrile on the silicone was carried out using radioinduced peroxides as a catalyst. (D.L.C.)

29728 (AEC-tr-6231(p.245-54)) CHEMICAL CHANGES OF ETHYLENE GLYCOL INDUCED BY GAMMA RAYS. Kouzou Hirota and Kiichiro Sanda. (Translation)

Gamma radiolysis of ethylene glycol was carried out in air and vacuum, and the yields of gaseous and liquid products were determined. Radiolysis of acetaldehyde, ethyl acetate, and acetal was also studied. The probable radiolytic mechanism is discussed. (D.L.C.)

29729 (AEC-tr-6231(p.255-62)) SYNTHESIS OF KETONES FROM MIXTURES OF ACETALDEHYDE AND

PROPYLENE BY GAMMA-RAYS. Kouzou Hirota, Motoyoshi Hatakeda, Shinji Meshitsuka, and Junichi Takezaki. (Translation)

The gamma-induced reaction of acetaldehyde with propylene was carried out at room temperature and found to be similar to the reaction carried out in the presence of catalysts. The reaction proceeds with chain propagation by CH_3CO as the chain carrier. The maximum G value for the decrease in acetaldehyde is ~110. (D.L.C.)

29730 (AEC-tr-6231(p.263-8)) PRODUCTS OF RADIATION-INDUCED REACTION OF ACETALDEHYDE AND ISOBUTYLENE. Kouzou Hirota, Shinji Meshitsuka, and Motoyoshi Hatakeda. (Translation)

Mixtures of acetaldehyde and isobutylene were gamma-irradiated in vacuum at room temperature, and the products were analyzed by gas chromatography, nuclear magnetic resonance, and infrared spectroscopy. Isobutyl methyl ketone and 2,4,4-trimethylheptane-2-one were among the identified products. (D.L.C.)

29731 (AEC-tr-6231(p.269-73)) ATTEMPT TO PRODUCE NITROSO COMPOUNDS BY IRRADIATION OF CYCLOHEXANE. Kouzou Hirota and Tadashi Iwai. (Translation)

Cyclohexane–NO mixtures were gamma-irradiated at 15°C, and the gaseous and liquid products were analyzed. The evolved gases were H_2, N_2, N_2O, and C_2H_4, and the liquids were cyclohexyl nitrate, nitrocyclohexane, cyclohexanone, and cyclohexanol. A solid formed in the reaction was identified as adipic acid. A possible reaction mechanism is proposed. Similar results were obtained with electron beams. (D.L.C.)

29732 (AEC-tr-6231(p.274-80)) GASES FROM RADIATION-INDUCED DISSOCIATION OF POLYVINYL CHLORIDE. Kouzou Hirota and Masami Oyabu. (Translation)

The oxygen absorbed by PVC in vacuum was determined by the isotopic dilution method, using ^{18}O. The temperature was found to have a great effect on the absorption. The yields of HCl and H_2 gases in gamma-irradiated PVC were measured for irradiations in air and vacuum. G(HCl) in vacuum decreased with dose from 17 to a constant value ~6 at ~40 Mr, while that in air remained constant at ~6. $G(H_2)$ is 0.15 to 0.20 in vacuum. (D.L.C.)

29733 (AEC-tr-6231(p.281-8)) MASS SPECTROGRAPHIC ANALYSIS OF DISSOCIATION OF ACETIC ACID AND HEAVY ACETIC ACID INDUCED BY ELECTRON BOMBARDMENT. Kouzou Hirota, Kazuo Nagoshi, and Motoyoshi Hatakeda. (Translation)

Electron-beam dissociation of CH_3COOH and CD_3COOH was studied by means of their mass spectra. The effects of ion source temperature and electron accelerating voltage on the mass spectra were determined. Appearance potentials of various ions were measured for both CH_3COOH and CD_3COOH. (D.L.C.)

29734 (AEC-tr-6231(p.289-91)) DECOMPOSITION OF PROPIONIC ACID BY ELECTRON BOMBARDMENT. Kouzou Hirota, Hei Otoba, Kenji Fuegi, and Motoyoshi Hatakeda. (Translation)

The mass spectra of propionic acid and propionic acid-d were studied using the quasi-equilibrium theory. Frequency factors were calculated and used to obtain the amounts of ions formed, which were found to agree well with experimental values. (D.L.C.)

29735 (AEC-tr-6231(p.292-309)) ELECTRON SPIN RESONANCE ABSORPTION STUDIES ON IRRADIATED HIGH POLYMERS. Isamu Nitta, Yuichi Ikeda, Shunichi Onishi, Mutsuo Kashiwagi, and Shunichi Sugimoto. (Translation)

The free radicals produced in the gamma irradiation of various polymers were studied by means of ESR spectra. The trapped free radicals were identified and quantitatively measured, and their reactions with oxygen were studied. The polymers used in these studies included polyethylene, polypropylene, polytetrafluoroethylene, polyvinyl alcohol, polyvinyl chloride, polymethyl methacrylate, polyethylene glycol, nylon 6, cotton, and Teflon. (D.L.C.)

29736 (AEC-tr-6231(p.310-17)) STUDY OF IRRADIATED NYLON 6 BY ELECTRON SPIN RESONANCE ABSORPTION. Kiyoshi Ite, Shunichi Onishi, and Isamu Nitta. (Translation)

ESR studies were carried out on the free radicals produced by gamma irradiation of untreated and I_2-treated nylon 6 in air and vacuum at room temperature. The decay of trapped radicals at different temperatures and the amount of gas formed by irradiation were investigated. It is concluded that the ESR spectra are not affected by crystalline structure and that $RO\cdot$ and $RO_2\cdot$ radicals are not formed in air. (D.L.C.)

29737 (AEC-tr-6231(p.318-19)) DISAPPEARANCE OF OXY-RADICALS IN IRRADIATED POLYPROPYLENE. Shigenobu Kawajima. (Translation)

The decay of oxy-radicals produced by gamma irradiation of polypropylene powder in air, was measured at temperatures ranging from 20 to 100°C. (D.L.C.)

29738 (AEC-tr-6231(p.320-8)) IRRADIATION EFFECTS OF Co-60 RADIATION ON POLYETHYLENE GLYCOL. Isamu Nitta, Shunichi Onishi, and Edata Fujimoto. (Translation)

Carbowax 6000 was gamma-irradiated at room temperature and the irradiation effects on the following properties determined: melting point, gel fraction, viscosity of aqueous solution, gas formation, x-ray-diffraction pattern, and infrared spectrum. The polymer becomes a gel at doses $>3.7 \times 10^8$ r. At 2×10^8 r, the background of the x-ray-diffraction pattern increases, and the crystalline band in the infrared spectrum decreases along with the appearance of OH and C=O bands. The G value decreases from 3.4 to 1.5 at 2×10^8 r. (D.L.C.)

29739 (AEC-tr-6231(p.329-38)) IRRADIATION EFFECTS ON POLYOXYMETHYLENE. Shigenobu Sobashima Shunichi Onishi, and Isamu Nitta. (Translation)

The effects of gamma rays (and, in some cases, electron beams) on polyoxymethylene were investigated for the following properties: melting point, intrinsic viscosity, amount and composition of gases liberated, production and decay of free radicals, and OH and C=O bands in the infrared spectrum.It is concluded that the principal chain of polyoxymethylene is degraded by radiation to give primarily CO_2, that it does not crosslink, and that the decomposition mechanism is quite complicated. (D.L.C.)

29740 (AEC-tr-6231(p.339-41)) EFFECT OF ADDITIVES ON GAMMA-RAY IRRADIATION OF DILUTE AQUEOUS POLYVINYL ALCOHOL SOLUTIONS. Kiyoshi Suzuki. (Translation)

Dilute aqueous PVA solutions were gamma-irradiated with and without additives, and the resulting changes in viscosity were measured. At a PVA concentration of 0.68 g/l, no change occurred, while at 2.38 g/l the viscosity increased, and at 5.95 g/l, gelation eventually occurred. The

addition of urea or NaOH eliminated such changes at all PVA concentrations. Similarly, dimethylsulfoxide but not boric acid had a suppressing effect on changes in viscosity. (D.L.C.)

29741 (AEC-tr-6231(p.373-95)) ELECTRON SPIN RESONANCE AND THE PHYSICAL STATE OF IRRADIATED POLYMERS. Naoyuki Tamura, Kyuji Kashiwabara, and Seiji Ogawa. (Translation)

Changes in intensities and shapes of ESR spectra of irradiated crystalline polymers due to changes in physical state were investigated. Gamma radiation or electron beams were used in the irradiations, and the polymers that were studied are polyethylene, polyethylene terephthalate, polyvinyl alcohol, polytetrafluoroethylene, and polytrifluorochloroethylene. It is concluded that motion of the molecular chain alone cannot determine the behavior of the radicals. (D.L.C.)

29742 (AEC-tr-6231(p.396-405)) IRRADIATION EFFECTS ON POLYPROPYLENE. Hiroshi Sofue, Beiho Tabata, and Takeo Ueno. (Translation)

The effects of gamma irradiation on atactic and isotactic polypropylene were studied. Gel yield, swelling degree, infrared absorption spectra, and ESR spectra were determined. The results are interpreted in terms of crosslinking, breaking of principal chains, structural changes, and behavior of free radicals. (D.L.C.)

29743 (AEC-tr-6231(p.406-17)) ELECTRON SPIN RESONANCE OF IRRADIATED TEFLON AND INFLUENCE OF OXYGEN AND HYDROGEN. K. Shinohara and T. Matsugashita. (Translation)

Results are presented of observations of ESR spectra of gamma-irradiated Teflon in vacuum and of the spectral changes caused by O_2, H_2, and D_2. The effects of heating at temperatures up to 250°C on the spectra were also studied. The probable reactions of the radicals with the gases are discussed, and the identity of the radicals is considered. The effects of O_2 on the ESR spectrum of polypropylene irradiated in vacuum were also investigated. (D.L.C.)

29744 (AEC-tr-6231(p.418-27)) IRRADIATED EFFECTS ON POLYVINYL ALCOHOL. S. Shida, Z. Kuri, and Y. Fujiwara. (Translation)

PVA was gamma-irradiated in vacuum at 20°C in order to investigate the free radicals and gases formed and the changes in structure. ESR, quantitative analysis, and infrared absorption spectra were used. (D.L.C.)

29745 (AEC-tr-6231(p.428-32)) CROSSLINKING IN POLYVINYL CHLORIDE. K. Shinohara, S. Shida, Z. Kuri, and J. Ueda. (Translation)

The crosslinking reactions of PVC after irradiation were studied. The effects of heating and addition of solvent after irradiation in vacuum on the gel formation were determined. Irradiations in air and ammonia gas were also carried out. The results show that crosslinking after irradiation occurs only when heat or a solvent is applied. (D.L.C.)

29746 (AEC-tr-6231(p.433-8)) ELECTRON SPIN RESONANCE ABSORPTION OF IRRADIATED POLYVINYL CHLORIDE. S. Shida, Z. Kuri, and J. Ueda. (Translation)

The free radicals formed by irradiation of PVC in different atmospheres were studied by means of their ESR spectra. The atmospheres used were vacuum, air, SO_2, HCl, N_2, CO_2, H_2O vapor, NH_3, NO_2, NO, Br_2, and H_2S. The probable reactions of the free radicals with the atmospheres are discussed. (D.L.C.)

29747 (AEC-tr-6231(p.439-50)) REACTIVITY OF ISOLATED RADICALS PRODUCED IN IRRADIATED HIGH-MOLECULAR COMPOUNDS WITH SO_2. S. Shida, Z. Kuri, and J. Ueda. (Translation)

The reactivity of free radicals in gamma-irradiated high-molecular compounds toward SO_2 were studied using ESR spectra of the compounds treated under the following conditions: irradiation in vacuum (V); irradiation in vacuum followed by reaction with SO_2 (T); and irradiation in SO_2 (S). The compounds giving a V=T=S response, i.e. whose ESR spectra in V were not changed by T or S, were cellulose, starch, Na–CMC, sodium alginate, and polyvinyl alcohol. The compounds with a V≠T=S response were polyethylene terephthalate, polymethyl vinyl pyridine, polypropylene, Teflon, polytrifluorochloroethylene, nylon, and cellulose acetate. The only compounds giving a V=T≠S response were polyvinyl acetate and polyvinyl chloride. These with a V≠T≠S response were polyethylene, polyacrylonitrile, polystyrene, and polymethyl methacrylate. The probable reactions for each type of response are discussed along with the reactivity of the radicals. (D.L.C.)

29748 (AEC-tr-6231(p.451-5)) IRRADIATION EFFECTS ON POLYVINYL FLUORIDE. T. Hoshino, K. Araki, and T. Abe. (Translation)

PVF was gamma-irradiated in vacuum, and the resulting free radicals and gas evolution were studied. The decay of the free radicals by heat was followed. The amounts of gas evolved with and without NaOH were determined. (D.L.C.)

29749 (AEC-tr-6231(p.456-62)) GAMMA-RAY IRRADIATION EFFECTS ON NATURAL RUBBER. H. Sofue, B. Tabata, and R. Shimozawa. (Translation)

The crystallization of natural rubber by elongation was studied by x-ray diffraction. The formation of free radicals by irradiation was studied for both nonelongated and elongated rubber by means of ESR spectra. Elongated rubber was found to give ~3.5 times more radicals than nonelongated rubber, and the probable cause of the elongated effect is discussed. The decay of radicals at room temperature and by heat treatments was followed. The elongation effect on the radioinduced crosslinking was determined. (D.L.C.)

29750 (AEC-tr-6231(p.463-8)) IRRADIATION EFFECTS ON POLYETHYLENE TEREPHTHALATE. H. Sofue, B. Tabata, and A. Hiraoka. (Translation)

The radiation crosslinking of polyethylene terephthalate was studied using gamma rays and electron beams. Solution viscosity, gel yield, and ESR of radicals were measured. It is concluded that: crosslinking occurs in vacuum irradiation, especially at high temperatures; O_2 has no effect on the breakdown of the main chain but hinders crosslinking; and the formation and disappearance of free radicals are 1st and 2nd order reactions. (D.L.C.)

29751 (AEC-tr-6231(p.469-76)) IRRADIATION EFFECTS ON POLYCARBONATES. A. Amamiya and S. Sekigawa. (Translation)

Commercial polycarbonate insulating films and powder were gamma irradiated as solid and solution in air and vacuum at 20°C. The effects on viscosity, infrared spectrum, tensile properties, and a few other properties were measured, and the gases formed were analyzed. It is concluded that a breakdown in the main chain between O and C=O takes place but no crosslinking occurs. (D.L.C.)

29752 (AEC-tr-6231(p.470-7)) GAMMA-RAY POLYMERIZATION OF 2-METHYL 5-VINYL PYRIDINE. H. Sofue, B. Tabata, and H. Kitano. (Translation)

Studies were carried out on the mechanism of gamma-induced polymerization of 2-methyl 5-vinyl pyridine. The

dependence of polymerization velocity on dose rate and temperature was determined. The polymer formed has a low degree of polymerization (200 to 400) which decreases with dose rate. The mechanism is a radical one in the liquid state and an ionic one in the solid state. (D.L.C.)

29753 (AEC-tr-6231(p.498-516)) SOLIDIFICATION OF UNSATURATED POLYESTER BY LOW TEMPERATURE RADIATION. K. Shinohara, T. Hoshino, Y. Shigematsu, K. Araki, and A. Kano. (Translation)

The mechanism of the setting process induced by gamma irradiation at low temperature was studied for various unsaturated polyester thermosetting resins with added modifier, monomer, and stabilizer. The effects of stabilizer, monomer, and polyester on the gel formation were investigated. The setting process is considered as a copolymerization and analyzed kinetically. Reaction constants are derived and their dependence on dose rate and temperature studied. The effects of radiation dose on the break strength and Young's modulus were determined. It is concluded that resins using vinyl acetate can be used successfully as radiation-setting resins. (D.L.C.)

29754 (AEC-tr-6231(p.517-24)) OXIDATION OF CYCLOHEXANE BY RADIATION. S. Shida, Z. Kuri, and K. Tsuruda. (Translation)

The mechanism of radioinduced oxidation of cyclohexane was investigated in air and oxygen, using liquid, solid, and aqueous solutions. The effects of ferrous and bromide ions on the reaction were studied. The yields of the cyclohexanone and cyclohexanol that were formed were determined. (D.L.C.)

29755 (AEC-tr-6231(p.525-33)) RADIATION CHEMISTRY OF ETHYLENE OXIDE. T. Hoshino, K. Araki, and M. Ichino. (Translation)

In an attempt to graft polymerize ethylene oxide on polyethylene, nylon, teflon, and polyvinyl chloride, the grafting percentages were very low. In order to explain this result, the homopolymerization and decomposition of ethylene oxide by gamma radiation were investigated. The polymer and acetaldehyde yields were determined, and the gases evolved were analyzed. It is concluded that the decomposition reaction proceeds by both radical and molecular mechanisms and dominates the polymerization reaction. (D.L.C.)

29756 EFFECT OF RADIATION ON AMMONIUM PERCHLORATE PROPELLANTS. T. Acker, E. Henley, R. F. McAlevy, III, and G. Odian (Radiation Applications Inc., Long Island, N. Y.). AIAA (Am. Inst. Aeron. Astronaut.) J., 2: 1165(June 1964).

Changes in burning rates and tensile strengths for ammonium perchlorate propellants x-irradiated with doses of 0, 10, and 50 Mrad by a 2-Mev Van de Graaff are presented. (M.J.T.)

29757 ON THE RADIATION CHEMICAL SULFOXIDATION OF CYCLOHEXANE. Dieter O. Hummel, Werner Mentzel, and Christel Schneider (Universität, Cologne). Ann. Chem., 673: 13-26(1964). (In German)

The irradiation of cyclohexane with γ rays from a ^{60}Co source, while a stream of SO_2 and O_2 (2:1) is passed through the cooled vessel, produced a mixture of cyclohexanesulfonic acid, sulfuric acid, and cyclohexane-1,2-diol 1-cyclohexanesulfonate 2-sulfate. Prolonged irradiation increased the yield of cyclohexanedisulfonic acid. The reaction proceeded with greatest yield at this ratio, which was twice the theoretical. The total yield of sulfonic acid increased linearly with time to about 25 hr, and was proportional to the square root of the radiation intensity. The rate passed through a maximum with respect to temperature at 60 to 70°C. Cutting off radiation decreased the rate of product formation; the new rate was dependent on the length of previous irradiation. Decomposition of the mixed diol diester and also of isolated cyclohexanepersulfonic acid were examined; the first decomposed into cyclohexanesulfonic acid and formylcyclopentane, which polymerized. The latter decomposed much more rapidly to give sulfonic acid and unknown oxidation products. The influence of water and several bases on the yield of products was examined. To explain the results, a radical mechanism is suggested similar to the one suggested by Graf (Ann. Chem., 578: 50(1952)) for an analogous reaction catalyzed by uv irradiation. (BBB)

29758 SCINTILLATION METHODS FOR THE MEASUREMENT OF RADIOACTIVITY OF SOLUTIONS OF ^{14}C-LABELLED COMPOUNDS. Rudolf Autrata (Czechoslovak Academy of Sciences, Brno). Chem. Listy, 58: 381-400 (1964). (In Czech.)

29759 RADIATION CHEMISTRY OF ORGANIC COMPOUNDS. Robert Schiller (Central Research Inst. of Physics, Budapest). Energia Atomtech., 16: 181-7(Apr. 1963). (In Hungarian)

29760 CHEMICAL SYNTHESES OF MARKED MOLECULES. Louis Pichat (CEN, Saclay, France). Euratom Bull., No. 2, 18-20(June 1964).

The preparation of tritiated molecules by exchange reactions is described. Chromatographic methods of purification and isolation of labeled compound prepared by chemical synthesis are outlined. The cost of radioisotopes, safety considerations, the relation between the position of the marked atom and the difficulty of synthesis, equipment for preparing the labeled compounds, and the importance of checking the radiochemical purity of the marked molecules are discussed. (M.C.G.)

29761 LABELLING BY RADIOCHEMICAL METHODS. Fulvio Cacace (Universitã, Rome). Euratom Bull., No. 2, 26-8(June 1964).

Methods of labeling compounds by nuclear recoil. Accelerated radioactive ions, and ionizing radiations are described and examples are given. The Wilzbach method for labeling with ^3H is also discussed. (M.C.G.)

29762 THE STORAGE OF MARKED MOLECULES. Klaus Hempel (Universität, Cologne). Euratom Bull., No. 2, 29-30(June 1964).

Problems in the storage of radioactively labeled organic compounds are described. Disintegration products arise from primary internal and external radiation effects and secondary radiation effects. Methods of reducing disintegration are discussed. (M.C.G.)

29763 THE FORMATION OF OZONE IN THE RADIOLYSIS OF GASEOUS OXYGEN. F. W. Lampe, E. R. Weiner, and W. H. Johnston (William H. Johnston Labs., Inc., Baltimore). Intern. J. Appl. Radiation Isotopes, 15: 363-71(June 1964).

Calculations of steady-state ozone yields and initial $G(O_3)$ values from the radiolysis of oxygen were carried out for initial oxygen concentrations of 2.46×10^{18} to 2.46×10^{20} molecules cm^{-3} and over a dose-rate range of 10^{15} to 5×10^{20} ev g^{-1} hr^{-1}. The calculated 100-ev yields of ozone, based on an assumed mechanism including both excitation and ionization, lay in the range of 9.9 to 17.9 and exhibit an inverse dependence on LET. It is shown that the inclusion of a radiation-enhanced catalytic wall decomposition of ozone allows the calculation of steady-state ozone yields that are in general agreement with reliable experimental results. (auth)

29764 GAS-PHASE DOSIMETRY BY USE OF IONIZATION MEASUREMENTS. G. G. Meisels (Union Carbide Corp., Tuxedo, N. Y.). J. Chem. Phys., 41: 51-6(July 1, 1964).

A basis is provided for the use of ionization measurements to evaluate energy absorption in gas-phase dosimetry when high-energy electrons are employed as the radiation source. It was concluded that total energy absorption can be determined and that stopping powers can be employed to calculate relative energy absorption in various gases. Scattering measurements indicated that irradiation cells should be short. Relative values of the energy required to form one ion pair (W) by 1-Mev electrons are shown to be the same as those reported for lower energy electrons, and the following W values for the partial absorption of 1-Mev electrons are reported with a probable error of about ±2%: C_3H_8 23.4, n-C_4H_{10} 22.9, i-C_4H_{10} 23.0, i-C_5H_{12} 23.9, C_3H_6 24.8, 1-C_4H_8 24.4, trans-2-C_4H_8 23.9, i-C_4H_8 24.4, CH_3CHO 26.4, $(C_2H_5)_2O$ 23.8, CO 32.2, SO_2 30.4, NO 27.5, N_2O 32.9, and NH_3 26.5. Chemical-yield measurements on ethylene suggested that the formation of acetylene can be measured with an accuracy of better than ±3%; above 400 torr and with dose rates in the order of 10^{15} ev $cc^{-1} \cdot sec^{-1}$ G(acetylene) = 3.07 ± 0.08. (auth)

29765 STATISTICAL THEORY OF KINETIC ENERGY OF FRAGMENTATION IN CERTAIN UNIMOLECULAR DISSOCIATIONS. Cornelius E. Klots (Florida State Univ., Tallahassee). J. Chem. Phys., 41: 117-22(July 1, 1964).

The quasiequilibrium theory, in both its usual form and with a modification applicable to "loose" transition states, was used to calculate the kinetic energies of fragments resulting from unimolecular decompositions. It was found that these statistical methods are capable of encompassing the presently available experimental results, except for two relatively unimportant reactions. An extension to the radiation chemistry of the liquid aliphatics was noted. (auth)

29766 ENERGY DEGRADATION OF ENERGETIC ATOMS AND HOT ATOM REACTIONS. Peder J. Estrup (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Chem. Phys., 41: 164-9(July 1, 1964).

The energy degradation of energetic (hot) atoms can be characterized by a parameter, α, termed the average logarithmic energy loss. In previous gas-phase studies of energetic atoms, α was calculated assuming rigid-sphere collisions. It is shown that α may be calculated using more realistic, "softer," intermolecular potentials, and the method was applied to the interaction of energetic hydrogen atoms with helium, methane, and hydrogen. Large differences were found between the rigid-sphere values and the soft-sphere values. The previously developed kinetic theory of hot atoms was not affected, but it is shown that the interpretation of hot-atom data depends strongly on which interaction model is assumed. In the case of hot hydrogen atoms the calculations indicated that values for both collisional energy transfers and reaction probabilities may be reduced by an order of magnitude when the soft-sphere model is used. (auth)

29767 GAMMA-INDUCED DIVALENT DYSPROSIUM IN CALCIUM FLUORIDE. Francis K. Fong (RCA Labs., Princeton, N. J.). J. Chem. Phys., 41: 245-54(July 1, 1964).

Experiments dealing with photochemical and thermal reactions of dysprosium in calcium fluoride are described. Trivalent dysprosium ions doped in calcium fluoride were reduced by gamma irradiation at room temperature. The efficiency of reduction of Dy^{3+} in CaF_2 is described in terms of the dosage of gamma radiation and concentration of the dopant ions. The optimum conditions for the photoreduction are given. The absorption band responsible for the reoxidation of the gamma-reduced dysprosium was determined. It was established that high densities of gamma-induced defect sites are necessary for the conversion of the majority of divalent ions to the trivalent state, which may be indicative of the tunneling of Dy^{2+} electrons to hole centers via the gamma-induced defect centers. The tunneling process is also believed to be responsible for the saturation of local and macroscopic concentrations of Dy^{2+} ions. The thermal reoxidation of Dy^{2+} ions is accompanied by bright luminescence, the spectrum of which resembles that of the photoluminescence of Dy^{3+} ions. The decay of the thermoluminescent emission bands is nonexponential, and the reaction kinetics fit the description of a second-order reaction. The evaluated activation energy (0.33 ev) is indistinguishable from the energy required for the thermal ionization of holes from V_1 centers in alkali halides. (auth)

29768 SWARM MEASUREMENT OF CROSS SECTIONS FOR DISSOCIATIVE ELECTRON CAPTURE IN HEAVY WATER, CHLOROBENZENE, AND BROMOBENZENE. J. A. Stockdale and G. S. Hurst (Oak Ridge National Lab., Tenn.). J. Chem. Phys., 41: 255-61(July 1, 1964).

One established method for the measurement of the cross section for electron capture involves the introduction of small quantities of the gas under study (sample gas) into a carrier gas, which determines the distribution of electron energies for specified values of E/P. A summary of the available information on the distribution of electron energies in ethylene, nitrogen, and argon shows that for E/P values ranging from 0 to 2.0 v cm^{-1} $torr^{-1}$ the three carrier gases can be used to cover the important range of electron energies between thermal energy and 10 ev. This method was used to study dissociative electron capture in D_2O, C_6H_5Cl, and C_6H_5Br. Measurements showed that the values for the energy-integrated dissociative capture cross sections are approximately 4.6×10^{-18} cm^2 ev for D_2O, 1.4×10^{-17} cm^2 ev for C_6H_5Cl, and 5.7×10^{-17} cm^2 ev for C_6H_5Br occurring at electron energies near 6.5, 0.76, and 0.70 ev, respectively. That the low-energy processes in C_6H_5Cl and C_6H_5Br correspond to dissociative capture was confirmed by the appearance of Cl^- and Br^- in a negative-ion time-of-flight mass spectrometer. (auth)

29769 ELECTRON SPIN RESONANCE ABSORPTION OF IRRADIATED NO_3OHCl. Hisashi Ueda (Duke Univ., Durham, N. C.). J. Chem. Phys., 41: 285-6(July 1, 1964).

Single crystals of hydroxylamine hydrochloride were irradiated at 77°K and a paramagnetic species, identified probably as a Cl_2^- ion, was found by means of electron spin resonance. A ^{60}Co gamma source was used for irradiation. (M.C.G.)

29770 IRRADIATION-INDUCED DE-ESTERIFICATION. A. MacLachlan (E. I. du Pont de Nemours and Co., Inc., Wilmington, Del.). J. Org. Chem., 29: 1598-1600(June 1964).

Solutions of benzyl esters in various solvents were efficiently de-esterified by high-energy electron irradiation. Dose rate and intensity effects were examined and a schematic mechanism proposed. In addition to synthetic applications, the efficient generation of acid can be used as an organic radiation dosimeter. (auth)

29771 THE EFFECT OF GAMMA-RAY IRRADIATION ON THE DIELECTRIC PROPERTIES OF SINGLE CRYSTALS OF SODIUM NITRITE. Kazuo Gesi and Yutaka

Takagi (Japan Atomic Energy Research Inst., Tokyo). J. Phys. Soc. Japan, 19: 632-9(May 1964).

The changes induced in the dielectric properties of $NaNO_2$ monocrystals by ^{60}Co gamma rays were measured. Depression of the Curie temperature, decrease of the maximum dielectric constant, increase of the coercive field and electric conductivity, appearance of weak double hysteresis loops, and a change in the activation energy were observed. The optical absorption spectrum of the specimen had an additional broad absorption band with a maximum around 400 mμ, which was assigned to neutral nitrite. (D.C.W.)

29772 PARAMAGNETIC CENTERS IN IRRADIATED $NaClO_3$ AND $NaBrO_3$. C. Ramasastry, S. B. S. Sastry, Y. V. G. S. Murthy, and J. Sobhanadri (Indian Inst. of Tech., Madras). J. Phys. Soc. Japan, 19: 770-1(May 1964).

The ESR spectra of $NaClO_3$ crystals subjected to gamma radiation were measured before and after partial thermal bleaching and brief electron irradiation, both of which gave similar results. The observations are explained in terms of the presence of O_2, O_3, and hyperfine interaction with Cl^{35} and Cd^{37}. No. ESR absorption was observed in irradiated $NaBrO_3$ crystals, and optical absorption showed the presence of only non-paramagnetic BrO^-. (D.C.W.)

29773 THE CONVERGENCE OF THE SERIES REPRESENTING THE MOLECULAR SIZE DISTRIBUTION FUNCTION IN IRRADIATED POLYMERS. Tôsaku Kimura (National Science Museum, Tokyo). J. Phys. Soc. Japan, 19: 777-8(May 1964).

The molecular size distribution function expressed as a series from Saitor's integrodifferential equation concerning crosslinking was previously shown to converge rapidly even after gelation. Convergence is verified for the case in which the initial (unirradiated) size distribution is the generalized Poisson distribution. (D.C.W.)

29774 NOTE ON THE DECAYING BEHAVIOUR OF THE FREE RADICALS OF ALKYL TYPE PRODUCED IN IRRADIATED POLYETHYLENE. Hisatsugu Kashiwabara (Hokkaido Univ., Sapporo). Japan J. Appl. Phys., 3: 302-3(May 1964).

Polyethylene materials were irradiated at 77°K, and their ESR spectra were obtained. The specimens were then heated to temperatures above 77°K and cooled to 77°K. Measurements of the intensities of the ESR spectra before and after heating gave relative concentrations corresponding to the remaining free radicals. The radicals appear to decay transitionally at three regions of temperature (near 140, 200, and 240°K). Free radicals trapped in irradiated polyethylene apparently decay with the initiation of the motion of the trapping molecules. (D.C.W.)

29775 THE p_H-DEPENDENCE OF THE RADIOLYTICAL PROCESSES OF DICHROMATE SOLUTIONS. Istvan Kósa-Somogyi, Istvân Kiss, and Robert Schiller. Magy. Kem. Folyoirat, 69: 206-9(May 1964). (In Hungarian)

$K_2Cr_2O_7$ solutions of 5×10^{-4} M in 0.8N sulfuric acid were completely reduced under the action of ^{60}Co γ radiation. The yield of the radiolytic reduction was G = 0.8 ions/100 ev. The reduction process was considerably affected by the p_H of the solution. A sharp break was observed in the reduction yield at $p_H = 2.5$. The marked decrease in yield was attributed to the individual p_H dependence of the secondary processes involved in the radiolysis of water (decomposition of H_2O_2 formed as a result of HO_2 dissociation) as well as to the p_H dependence of the reduction processes of Cr(VI). The radiolytic reduction of dichromate solutions in the concentration range from 10^{-3} to 10^{-4} M $(Cr_2O_7)^{2-}$ in 0.8N sulfuric acid appeared to be a first-order reaction, induced by the radical products of steady concentration formed in the radiolysis of water. The reducing and oxidizing processes attained equilibrium above the value $p_H = 4$, consequently the concentration of Cr(VI) remained virtually unchanged under the action of radiation. (auth)

29776 ELECTRICAL CONDUCTION IN PLASTICIZED POLYVINYLCHLORIDE EXPOSED TO HIGH ENERGY RADIATIONS AND ITS POST-IRRADIATION EFFECT. Masayuki Ieda, Masamitsu Kosaki, and Ukichi Shinohara. Mem. Fac. Eng., Nagoya Univ., 15: 117-21(May 1963).

The volume resistivity of plasticized polyvinylchloride exposed to three kinds of radiation field, (atomic pile, gamma, and electron) was investigated at temperatures of 20 to 70°C, and for specimen thicknesses of 0.1 to 2 mm. The volume resistivity measured for about a year after irradiation showed a post-irradiation effect, which depended markedly on both the specimen thickness and the plasticizer concentration mixed in polyvinyl chloride. The experimental results also showed that the creation of charge carries, such as H^+ and Cl^- in the degradation by irradiation, causes decreasing volume resistivity with increasing radiation dose through ionic conduction. And the post-irradiation phenomena showing a recovery on the reduced volume resistivity were related to the disappearance of the created charge carriers due both to their diffusion out of the specimen and their capture in the trapping centers in the specimen, but not due to the change of ion mobility. (auth)

29777 PORPHINE-LIKE SUBSTANCES: PROBABLE SYNTHESIS DURING CHEMICAL EVOLUTION. Anton Szutka (Univ. of Detroit). Nature, 202: 1231-2(June 20, 1964).

Aqueous suspensions of pyrrole and benzaldehyde were irradiated at room temperature with either ultraviolet or visible light or placed in semi-darkness without irradiation. In all cases a porphine-like substance, α,β,γ-δ-tetraphenylporphine, was obtained. The probable synthesis of porphine-like substances during chemical evolution is discussed. (C.H.)

29778 ON THE NEUTRON ACTIVATION OF PHOSPHATIDES. J. Hoelzl (Universität, Munich). Naturwissenschaften, 51: 241(1964). (In German)

An experiment was undertaken to activate a phosphatide mixture by neutron irradiation before separation and to calculate the contents of the mixture by determination of the specific activities. A neutron flux of 5×10^{12} n/sec · cm^2 for 30 min was used for irradiation. It was concluded that this method can be used in determining phosphatides. (M.C.G.)

29779 LET EFFECTS IN RADIATION CHEMISTRY. Masashi Imamura. Nippon Genshiryoku Gakkaishi, 6: 218-27(Apr. 1964). (In Japanese)

Effects of linear energy transfer (LET) on product yields in the radiolysis of water were studied and explained satisfactorily by the diffusion theory developed by Magee et al. If similar discussions are assumed applicable to liquid systems other than water, more detailed mechanisms of the radiolyses must be obtained. Studies of LET effects on methanol, cyclohexane, cyclohexene, benzene, and benzene derivatives are reviewed. Some special systems are also reviewed briefly. (auth)

29780 RADIOLYSIS OF CYSTEINE AND BISCYSTEINOCOBALTATE(III) IN AQUEOUS SOLUTION BY ^{60}Co γ-RAYS.

Niro Matsuura (Tokyo Univ.), Kazuko Muroshima, and Masao Takizawa. Nippon Kagaku Zasshi, 85: 268-75(Apr. 1964). (In Japanese)

Yields of the radioinduced degradation of cysteine and biscysteino-cobaltate(III) were observed to be strongly dependent upon their concentrations. From the intercept of the graphs of 1/G plotted against 1/C, the extrapolated yields of degradation at an extremely high solute concentration can be obtained and these values are balanced stoichiometrically with the yields of decomposed solute and the radicals from solvent water. The values are $G_{-CySH} = 10.5 \pm 0.5$, $G_{-CySH} = 7.5 \pm 1.0$ for cysteine and $G_{-Co(CyS)_2} = 12.5 \pm 0.5$, $G_{-Co(CyS)_2} = 13 \pm 1$ for biscysteino-cobaltate(III) in the presence and absence of oxygen. The yields are too high as compared with the known primary radical yields in the radiolysis of water. In order to interpret the results in accordance with the radical diffusion hypothesis, a redox reaction in which one radical decomposes two solute molecules has to be assumed. Chain mechanism cannot be involved in the interpretation because the experiments revealed that the chain oxidation of cysteine occurred in the presence of Fe^{2+} with G_{-CySH} as large as 100. It would thus be conceivable that the contribution of an excited water molecule or excess energy transferred by radical recombination that renders a disproportionation without any redox reaction is present. (auth)

29781 THE PREPARATION OF SOURCES OF Co^{57} FOR MÖSSBAUER EXPERIMENTS HAVING NARROW UNSPLIT EMISSION LINES. A. Mustachi (Hebrew Univ., Jerusalem). Nucl. Instr. Methods, 26: 219-20(Mar. 1964).

A detailed procedure for the preparation of sources of ^{57}Co for Mössbauer experiments, having narrow unsplit emission lines, is described. (auth)

29782 DISTRIBUTION OF THE SPIN DENSITY OF THE UNPAIRED ELECTRON IN THE MACRORADICAL FORMED IN γ-IRRADIATED POLYSTYRENE. E. V. Suntsov and M. P. Votinov. Opt. Spectry. (USSR) (English Transl.), 16: 296-7(Mar. 1964).

A calculation by the molecular orbits method in a π-electron approximation is used to show that the triplet structure of the EPR spectrum from the macroradical formed in γ-irradiated polystyrene is not associated with interaction of the unpaired electron with the phenyl ring. (L.B.S.)

29783 ENERGY MIGRATION AND ISOTOPIC EFFECTS IN IRRADIATED SOLIDS AT LOW TEMPERATURE. Walter V. Bouldin and Walter Gordy (Duke Univ., Durham, N. C.). Phys. Rev., 135: A806-14(Aug. 3, 1964).

Energy migration to impurity molecules of hydrogen and methane trapped in solid matrices of argon and krypton at low temperature is shown to occur. The solid containing the impurity molecules in minute quantities was irradiated at 4.2°K with γ rays from ^{60}Co, and the free radicals produced by dissociation of impurity molecules were measured from the intensity of their electron spin resonance signals. For concentrations of 0.001 mole fraction of CD_4 in Ar or Kr, over 500 times as many molecules of CD_4 were dissociated as would be expected from the same quantity of pure CD_4 given the same exposure dose. It is concluded that the dissociation of the dilute impurity is produced almost wholly by the energy absorbed by the matrix and transferred to the impurity molecules. In the mixed isotopic species— HCD_3, H_2CD_2, and H_3CD— it is shown from the relative strength of the ESR signals of H and D atoms that the C–H bond has about 5 times greater probability of being broken by the migrating energy than has a given C–D in the same molecule. This large isotopic effect is attributed to the more rapid escape of H over D from the parent molecule within the lattice. (auth)

29784 COMMENT ON g-SHIFTS IN THE ELECTRON PARAMAGNETIC RESONANCE OF F-CENTERS. F. Hughes (Naval Research Lab., Washington, D. C.). Phys. Status Solidi, 5: 55-61(1964).

Calculations for the theoretical g-shift in the electron paramagnetic resonance of F-centers, which is induced by nuclear hyperfine interactions, are discussed. For cases requiring only the use of the contact hyperfine term of the first shell of nuclei, the computed g-shift was found to be too small to be of interest. For F-centers with large anisotropic hyperfine interaction constants, the concept of a hyperfine-induced g-shift may be given meaning only in terms of an electron-nuclear double resonance experiment. Under these circumstances, the experimentally observed hyperfine g-shifts are comparable to the shifts induced by spin-orbit effects, but the theoretical computation would require an extensive computer program. It is considered that the computation of such g-shifts is of only formal interest, since the sign of the experimentally determined g-shift is not a positive definite criterion for assignment of the sign of the electronic charge of a paramagnetic radical. (auth)

29785 THERMOLUMINESCENCE AT LOW TEMPERATURES OF LiF CRYSTALS. J. Tournon and P. Berge (CEN, Saclay, France). Phys. Status Solidi, 5: 117-21 (1964). (In French)

Lithium fluoride crystals, γ irradiated at room temperature, were excited in the F-center band at 78°K. When heated the crystals emitted peaks of thermoluminescent light at 100 and 150°K. The quantities of emitted light depended on the time of irradiation, the time of excitation, and on the number of thermoluminescence experiments performed, starting from a fresh crystal. A model is proposed to explain the experimental results. (auth)

29786 RADIATION-INDUCED POLYMERIZATION AT HIGH PRESSURE OF n-TETRADECAFLUOROHEPTENE-1; 1,1,2-TRIFLUOROVINYL PHENYL ETHER; AND 1,2,3,4,5-PENTAFLUOROPHENYL 1,1,2-TRIFLUOROVINYL ETHER. Daniel W. Brown and Leo A. Wall (National Bureau of Standards, Washington, D. C.). SPE (Soc. Plastic Engrs.) Trans., 3: No. 4, 1-8(Oct. 1963).

The kinetics of the radioinduced polymerization of n-tetradecafluoroheptene-1 at high pressure were investigated in detail and is reported. Certain related results obtained with 1,1,2-trifluorovinyl phenyl ether and 1,2,3,4,5-pentafluorophenyl 1,1,2-trifluorovinyl ether are also described. Molecular weights, rates of polymerication, and thermodynamic functions of the polymerizations were determined, and the mechanism of the heptene polymerization is described. (P.C.H.)

29787 THE EXTRACTION OF $UX_1(Th^{234})$ FROM THE URANYL SOLUTION FOR PREPARING THORIUM-LABELED COMPOUNDS. A. K. Shtol'ts. Tr. Ural'sk. Politekhn. Inst., [No.] 121, 49-54(1962). (In Russian)

Sorption of $UX_1(^{234}Th)$ on wood charcoal from aqueous uranyl solutions was studied. A method for preparing Th compounds labeled with ^{234}Th by sorption from aqueous solutions is described. Data are given on the preparation of labeled thorium nitrates, chlorides, and sulfates. (R.V.J.)

29788 RADIATION CHEMISTRY OF AMMONIACAL SYSTEMS. F. S. Dainton, T. Skwarski, D. Smithies, and

E. Wezranowski (Univ. of Leeds, Eng.). Trans. Faraday Soc., 60: 1068-86(June 1964).

The effects of variation of dose, dose rate, and temperature on the various yields resulting from ^{60}Co γ irradiation of liquid, glassy, and crystalline ammonia and ammoniacal solutions containing NH_4Cl, KNH_2, N_2O, $^{15}N_2O$, N_2H_4, or vinyl monomers are reported. These results and those of other workers are interpreted according to a scheme in which the primary radiolysis is $G_{-NH_3}NH_3 \xrightarrow{\gamma} G_e - e^-_{am} + G_{NH_2}NH_2 + G_{H_2}H_2 + G_{N_2H_4}N_2H_4$. H atom and NH radicals may be formed but, if not, $G_{e^-} \propto G_{NH_2}$ = about 0.35, $G_{H_2} = 0.84 \pm 0.25$, $G_{N_2H_4} = 0.9 \pm 0.5$, and $G_{-NH_3} = 2.1$ ($G_{-H_2O} = 3.8$). Esr (electron spin resonance) signals of NH_2 and ND_2 were observed in crystalline NH_3 and ND_3 irradiated with γ rays or 1849 Å light. N_2H_4 and N_2O react with both e^-_{am} and $\cdot NH_2$ radicals. At −60°C acrylamide reacts with e^- undergoing rapid anionic polymerization, which is terminated by NH_2 radicals. The radical anion $\cdot NH^-$ formed in alkaline solutions reacts destructively with $H_2(\rightarrow e^-_{am})$ and N_2O ($\rightarrow N_2 + OH^-$) and is a poor terminator of anionic polymerization. As in water the reaction $NH_4^+ + e^- \rightarrow NH_3 + H$ is slow and in the glassy state the decomposition is greater than in the crystalline state. (auth)

29789 RADIOLYSIS OF AIR-FREE AQUEOUS SOLUTIONS OF HYDROGEN PEROXIDE. E. Hayon (CEN, Saclay, France). Trans. Faraday Soc., 60: 1059-67(June 1964).

A study of the chemical changes resulting from high-energy irradiation of water was made with the purpose of elucidating the nature of the primary species formed, and the possible effect of oxygen on their formation. Hydrogen peroxide was chosen as solute because the rate constants of the reactions of the radiation-induced species are known. It is shown that in an initially oxygen-free neutral peroxide solution H atoms as well as electrons, $(H_2O)^-$, are formed on irradiation. As the decomposition of H_2O_2 proceeds sufficient oxygen is formed to react with the precursors of the H atoms such that all the reducing species produced are in the form of $(H_2O)^-$. The precursors of H atoms are probably excited water molecules, $H_2O^* \rightarrow H + OH$, and it is suggested that in the presence of about 70 μM of O_2, or more, the effect of oxygen is to quench all the H_2O^*, by a mechanism involving an electron transfer, $H_2O^* \rightarrow (H_2O)^+ + (H_2O)^-$. The lifetime of H_2O^* is estimated to be 10^{-6} to 10^{-7} sec and is probably longer. (auth)

29790 EFFECT OF U.-V. RADIATION DAMAGE ON THE OPTICAL AND ELECTRICAL PROPERTIES OF NUCLEIC ACIDS. Ronald S. Snart (Indiana Univ., Bloomington). Trans. Faraday Soc., 60: 1178-83(June 1964).

The result of cross-linking DNA by irradiation with 260 mμ light was to increase the conjugation of the base pairs in the molecule. This increased conjugation seemed to result in an increase in the hyperchromicity of the nucleic acid, which on the basis of Tinoco's theory provided further evidence in favor of the assignment of 300 mμ as the $n \rightarrow \pi^*$ absorption wavelength. The electrical properties of solid gels of DNA irradiated with 260 mμ light (9.4×10^4 μ watts/cm^2) showed a million-fold increase in conductivity after 5 min irradiation, after which the conductivity gradually decreased. Samples that were irradiated in concentrated solution before setting as solid gels showed a semiconductive behavior in which the activation energy decreased from 2.44 ev for native DNA to 0.55 ev after 15 min irradiation. The activation energy then increased with longer irradiation periods and reached a constant value of 1.63 ev after 60 min irradiation. (auth)

29791 STUDIES IN RADIATION POLYMERIZATION. III. THE RADIATION POLYMERIZATION OF PIPERYLENE IN THE CHANNEL COMPLEXES OF UREA. V. S. Ivanov, T. A. Sukhikh, Yu. V. Medvedev, A. Kh. Breger, V. B. Osipov, and V. A. Goldin. Vysokomolekul. Soedin., 6: 782-6(May 1964). (In Russian)

Complexes of urea and piperylene were subjected to the action of Co^{60} γ rays. Piperylene prepared by radiation channel polymerization is of higher molecular weight and of a more ordered microstructure than the polymer prepared by radiation polymerization in bulk, besides forming with higher radiation−chemical yield. (auth)

29792 RADIATION POLYMERIZATION OF HEXAFLUOROPROPYLENE IN THE LIQUID AND SOLID PHASES. E. V. Volkova and A. I. Skobina. Vysokomolekul. Soedin., 6: 964(May 1964). (In Russian)

It was shown that under the action of Co^{60} γ radiation, hexafluoropropylene polymerizes at the same rate in the solid and liquid phases of the monomer. The polymerization kinetics both in the liquid and solid phases were investigated with respect to the dosage, dose rate, and temperature. (auth)

29793 ELECTROCHEMISTRY OF THE RADIATION PROCESSES. Jerzy Sobkowski. Wiadomosci Chem., 18: 201-13(1964). (In Polish)

A review is presented on problems in the effects of ionizing radiation on reduction and oxidation reactions of inorganic ions. Electrochemical processes at metal−solution interface is included. (P.C.H.)

29794 THE SCINTILLATION LIGHT OUTPUT OF ENERGETIC DEUTERONS AND α-PARTICLES IN ORGANIC CRYSTALS. Wolfram Schoett (Universität, Gottingen, Ger.). Z. Physik, 179: 428-38(1964). (In German)

The light output of anthracene and terphenyl bombarded with deuterons from 8 to 25.3 Mev and with α particles from 20 to 49.5 Mev was measured as a function of energy. Both anthracene and terphenyl gave for low energies a nonlinear response tending towards linearity above 18 Mev for deuterons and 35 Mev for α particles. The dependence of the light output upon the impact direction of the incident particles was found not to be disappearing even at highest energies, but in contrast there appear new fine structures. Further on the specific light output dS/dx vs specific energy loss dE/dx was investigated in direct measurements on thin crystals. The quantity dS/dx depends on the impact direction even at dE/dx = 35 kev/mg cm^{-2}. (auth)

29795 SPECTRA OF ELECTRON PARAMAGNETIC RESONANCE FOR CERTAIN γ AND PHOTOIRRADIATED DI-SUBSTITUTED ACETYLENES. V. I. Smirnova, T. S. Zhuravlev, D. N. Shigorin, E. P. Gracheva, and M. F. Shostakovskii (Karpov Inst. of Physics and Chemistry, Academy of Sciences, USSR). Zh. Fiz. Khim., 38: 469-71(Feb. 1964). (In Russian)

An electron paramagnetic resonance method was used in an analysis of radical structures formed in methylphenyl, ethylphenyl, deuteromethylphenyl acetylene and dimethylacetylene irradiated with 2 to 80 Mr of γ rays and with ultraviolet. In compounds with $Ar-C\equiv C-R$ and $R-C\equiv C-R$ structures, radicals are formed as a result of hydrogen stripping from methyl and methylene groups. In $Ar-C\equiv C-\dot{R}$, ($\dot{R}_1 = \dot{C}H_2$, $\dot{C}H-CH_3$) the free electron is located in the $\dot{R}_1$ group, while in $R-C\equiv C-\dot{C}H_2$ (similar to $|CH_2=C\equiv CH|$) the non-evaporated electron is delocalized by the triple bond. (R.V.J.)

29796 RADIOAKTIVNYE IZOTOPY KRIPTONA I KSENONA. (Radioactive Isotopes of Krypton and Xenon). V. I. Levin. Moscow, Atomizdat, 1964. 26p.

The properties of stable and radioactive isotopes of Kr and Xe are treated, and the processes of their formation by neutron irradiation of natural isotopic mixtures in a reactor and of their accumulation in uranium fission are described. Technological processes of obtaining and purifying xenon-133, krypton-85, and krypton-79 are discussed. Examples of applications in various spheres of technology and medicine are given. (tr-auth)

29797 THE SCINTILLATION MECHANISM IN THALLIUM ACTIVATED SODIUM IODIDE. I. Cooke and R. Palser (Univ. of Manitoba, Winnipeg, Can.). 12p. (CONF-182-25)

From 9th Scintillation and Semiconductor Counter Symposium, Washington, D. C., Feb. 1964.

The emission and transmission of pure and Tl-activated NaI crystals have been studied as functions of wavelength and plastic deformation in the sample. The results show an increase in emission at 0.42 micron for the NaI(Tl) phosphor, and a probable decrease for the pure NaI specimen. In pure NaI three emission bands, located at 0.33, 0.375, and 0.42 micron were observed. The 0.42-micron band in both NaI(Tl) and NaI is associated at least in part with chemical contamination of the surface. Some reduction in absorption in both the activated and pure crystals was observed upon increasing the dislocation density. (auth)

Separation Processes and Procedures

29798 (ASD-TDR-63-703) AN ANALYTICAL STUDY ON LIQUID CESIUM PURIFICATION IN VIEW OF CURRENT AND PROJECTED NEEDS. Richard H. Herald (Aeronautical Systems Div., Wright-Patterson AFB, Ohio). Sept. 1963. 31p. (AD-427179; CONF-544-1)

From the 10th Annual Air Force Science and Engineering Symposium, Colorado Springs, Colo., Oct. 1963.

The use of liquid alkali metals as a heat transfer medium or motive fluid for power conversion systems has increased significantly in recent years and has created new demands in the area of liquid alkali metal handling technology. Contaminants existing in liquid alkali metal systems may exert deleterious effects on thermophysical properties, corrosivity, and handling characteristics. This paper presents an analytical study on the physicochemical and kinetic aspects of liquid cesium purification, employing the hot gettering technique. The properties and various aspects of handling sodium, potassium, rubidium, and cesium are reviewed. Typical sources of contamination are discussed. (auth)

29799 (CEA-2361) CONTRIBUTION A LA CHROMATOGRAPHIE DES GAZ DE L'AIR (THESES). (Contribution to the Chromatography of Atmospheric Gases (thesis)). Abolghassem Ghalamsiah (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1963. 86p.

Submitted to Paris Universite.

The gas-phase chromatographic separation of the atmospheric rare gases, of hydrogen, and of some gaseous compounds of carbon (CO, CO_2, CH_4) is studied using inactive gases to obtain the most favorable operational conditions for the separation. The optimum conditions for detecting non-active gases using an ionization chamber and a ^{239}Pu radioactive source emitting 5.15 Mev α particles are determined. (auth)

29800 (HW-46093) PILOT PLANT DISSOLUTION OF UNJACKETED FUEL ELEMENTS. T. F. Evans (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 15, 1956. Contract W-31-109-eng-52. 38p.

The dissolutions of uranium metal with nitric acid, involves two operations: (a) the actual dissolution of uranium with nitric acid to form uranyl nitrate and by-product nitrogen oxides, and (b) the recovery (as nitric acid) of the by-product nitrogen oxides in an absorber. The two operations are carried out in a dissolver pot surmounted with an absorber which returns recovered nitric acid to the dissolver pot. A pilot plant batch dissolution study was carried out to obtain the data required for the design of the Purex Plant dissolvers. Particular emphasis was placed on the rate of dissolution and the efficiency of nitrogen oxide recovery from the dissolver off-gas. The results of pilot plant dissolution runs were correlated to permit the estimation of the dissolution rate of uranium for acid concentrations between 0.2 to 10 M, total nitrate concentrations between 6 and 10 M, and varying effective surface areas. The rate data have been compared with similar data from other studies. Although the data from each series of experiments are reasonably consistent, the large differences between series indicate unexplained sources of variance, and no general correlation was found which would fit the data from different sources. Under the particular test conditions used, the results showed an average of 3.3 moles of acid consumed per mole of uranium dissolved and had a range of 2.6 to 3.8 moles. The theoretical minimum was 2.0 moles consumed, at 100 per cent recovery. (D.L.C.)

29801 SEPARATION OF ELEMENTS ON ION-EXCHANGE RESINS IN NON-AQUEOUS SOLUTIONS AND IN MIXED ORGANIC-AQUEOUS SOLVENTS. Jarmila Prasilova (Faculty of Technical and Nuclear Physics, Prague). Chem. Listy, 58: 401-16(1964). (In Czech.)

29802 CALCULATION OF THE EXTRACTION OF THE TRINITRATO COMPLEXES OF NITROSYLRUTHENIUM IN THE PRIMARY SEPARATION PLANT OF REACTOR FUEL PROCESSING. [PART] II. M. Takigishi (Atomic Fuel Corp., Tokyo). J. Nucl. Energy, Pt. A & B, 18: 261-77 (May 1964).

A mathematical treatment to determine the optimum flow ratio and the decontamination factor for the countercurrent extraction of penta- and tetravalent complexes of nitrosylruthenium in the primary separation section of a reactor fuel reprocessing plant has been developed. The optimum flow ratio is a rather simple function of ratio of reaction-rate constants and molar ratio of trinitrato complex to penta and tetra complexes. The decontamination factor is a complex function of reaction-rate constants, number of stages, mixing time per bank, and the volume flow ratios of solvent, feed, and strip, which may be converted to the optimum flow ratio. Further calculations provide an analysis of the operation of ruthenium decontamination and the role of repeated decontamination treatments or cycles of operation. (auth)

29803 ZONE MELTING OF RADIOACTIVE SUBSTANCES. H. Schildknecht (Universitlit, Heidelberg). Kerntechnik, 6: 249-53(June 1964). (In German)

Normal freezing and zone melting are two crystallization procedures for isolating very small amounts of radioactive compounds from water, and also for preparing pure materials. Retene and β-Sitosterol were labeled this way with tritium by the exchange method. Utilization of the

characteristic decomposition of organic substances by radiation, is illustrated as an ultra-micro-disintegration for structure determination of organic compounds. The separation of organic isomers by zone-melting is observed by the addition of labeled material just as the purification of salts in inorganic chemistry is followed by the addition of radioactivated nuclides and by autoradiography. By means of the system cetyl-stearylalcohol the combination of micro-zone melting techniques with the self-registration of radioactive compounds is explained. (auth)

29804 NOTES ON ISOTOPIC EXCHANGE REACTIONS. III. THERMODYNAMICS OF ION EXCHANGE EQUILIBRIUM. Kenji Ishida (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 6: 249-53(May 1964). (In Japanese)

A statistical thermodynamic investigation of isotopic ion exchange equilibrium showed that it is reasonable to ascribe the possibility of enrichment to the quantum effect of the internal vibration of a hydrated ion. It was possible, to some extent, from the phenomenological definition of separation factor, to determine quantitatively the effects of chemical properties of the external solution and the cross-linkage of the exchanger on the separation factor. (auth)

29805 RADIOGASCHROMATOGRAPH FOR CARBON-14 AND TRITIUM-LABELLED ORGANIC COMPOUNDS. L. Bruzzi (Università, Bologna), A. Castelli, and A. Cervellati. Nucl. Instr. Methods, 26: 305-13(Mar. 1964).

The apparatus consists of a vapor phase chromatograph and a flow proportional counter, that may be used up to 200°C. The whole device allows the carrying out of the gas chromatographic separation and continuous radioactivity measurement of organic molecules labeled with ^{14}C and ^{3}H. For labeled molecules with ^{14}C, the sensitivity is of 0.2 mμC. The systematic controls carried out on the behavior of the proportional counter with the variation of the composition of counting gas mixture, temperature, shielding, and combustion oven, are presented to give the optimal functioning conditions. The data presented give useful indications for the construction of this apparatus and for the use of this technique. (auth)

29806 A NUCLEONICS SURVEY—FUEL-CYCLE SERVICES OFFERED BY AMERICAN COMPANIES. Nucleonics, 22: No. 7, 60-3(July 1964).

The capabilities of the fuel-processing, fuel-fabrication, waste-disposal, and spent-fuel-transportation services in the United States are tabulated. The fuel reprocessing plant under development by Nuclear Fuel Services is briefly described. (D.C.W.)

29807 PRODUCTION OF CO_2 FOR ISOTOPIC ANALYSIS C^{12}/C^{13}. A. A. Bolotnikov and Ya. B. Finkelshtein. Pribory i Tekhn. Eksperim., No. 2, 172-4(Mar.-Apr. 1964). (In Russian)

A device for the production of CO_2 from liquid and gaseous organic compounds by combustion and from inorganic carbonates by a thermal dissociation method is described. The impurity content of the CO_2 is $\sim 10^{-4}$%. (tr-auth)

29808 ON THE SEPARATION OF INORGANIC MATERIAL MIXTURES BY DISTRIBUTION BETWEEN TWO FLUID PHASES. 14. ON THE SEPARATION OF HAFNIUM FROM ZIRCONIUM BY PARTITION OF THEIR THIOCYANATES. Werner Fischer and Hans-Peter Pohlmann (Technische Hochschule, Hanover). Z. Anorg. Allgem. Chem., 328: 252-66(Apr. 1964). (In German)

The partition coefficients of zirconium and hafnium thiocyanates between solutions of thiocyanic acid in water and in hexanone were systematically investigated. They decreased strongly with increasing total concentration of (Zr + Hf); this included the fact that the two metals interact with one another. The partition coefficients went through a distinct maximum with increasing concentration of HSCN. They decreased with increasing concentration of H^+ ions; the influence of Cl^- ions was small. The separation factors varied much less than the partition coefficients did. A qualitative explanation of the results was attempted. (auth)

29809 SEPARATION OF COLLOIDAL THORIUM OXIDE FROM CHLORINE IONS IN SILICA GEL COLUMNS WITH DIFFERENT KINDS OF FUNCTIONS OF THE SILICA GELS. H. W. Kohlschuetter and W. Katzenmayer (Technische Hochschule, Darmstadt, Ger.). Z. Anorg. Allgem. Chem., 329: 163-71(May 1964). (In German)

Variations of surface properties of silica gels by adsorption of thorium ions and by hydrolysis of the adsorbed thorium ions are described. Separation of colloid thorium oxide and Cl^- ions was carried out in columns with pure silica or with silica after adsorption of thorium ions. Proofs and discussions of the different reasons for these separations are given. (auth)

ENGINEERING

General

Refer also to abstracts 29925 and 30484.

29810 (COO-1028-2) PIQUA-ELK RIVER REACTORS SPENT FUEL SHIPPING CASK. Thermal Test Report. (Knapp Mills Inc., Wilmington, Del.). May 29, 1964. Contract AT(11-1)-1028. 70p.

A test program designed to verify the thermal design and obtain performance data on the Piqua-Elk River Spent Fuel Shipping Cask was carried out in February and March 1964. Tests with the cask water-filled and dry were performed. Also, cooldown tests designed to bring the dry cask from relatively high internal equilibrium temperatures to immersion temperatures for unloading were performed. Test results are in good agreement with design calculations. Areas in which analysis was known to be conservative are evident from the test data. Cask design is based on the requirement to ship 19 Piqua and Elk River Reactor fuel assemblies which have operated at full power for design core life in the hottest region of the core within 120 days after reactor shutdown. Dry test results show that the cask meets this requirement with slightly lower maximum fuel temperatures than calculated. Wet test results show that the cask has additional heat dissipating capacity beyond that required. Ability to safely cool the dry cask was demonstrated and sufficient data were obtained from cooldown tests to develop a standard air-water cooldown procedure and alternate steam-water procedure. Inspection of cask and internal components after completion of test program showed that thermal cycling had no detrimental effects on the cask assembly. Based on test results extrapolated to design conditions of 100°F ambient and maximum solar heat, cask capacity is 36,000 Btu/hr water-filled and 28,000 Btu/hr dry using 10 CFR 72 limitation on maximum accessible surface temperature of 180°F. Based on 10 CFR 72 limitation of 50 psig maximum allowable internal pressure, cask capacity water-filled is estimated at 56,000 Btu/hr. Since the 28,000 Btu/hr capacity is 4% less than Piqua design heat load, an additional decay time of approximately 10 days may be required to fully comply with 180°F accessible surface temperature limitation in 10 CFR 72. (auth)

29811 (HW-SA-3356) WATER HAMMER IN A COMPLEX PIPING SYSTEM, COMPARISON OF THEORY AND EXPERIMENT. Stephen S. Jones (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 1964. Contract [AT(45-1)-1350]. 27p. (CONF-562-1)

From the Naval Reserve Research Company No. 13-2, Richland, Wash., Feb. 1964.

At Hanford, a complex of 28 miles of pipeline provides the raw water requirements of the Chemical Processing Dept. and the emergency water supply of the reactor areas. Loss of export pumping power causes water hammer pressure surge effects which are discussed. A theoretical program using Bergeron graphical analysis was developed to treat the water hammer problems, and some of the results are compared with experimental data. (D.L.C.)

29812 (HW-SA-3546) AN AUTOMATED NUCLEAR MATERIALS ACCOUNTING SYSTEM. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 1, 1964. Contract [AT(45-1)-1350]. 42p.

An automated accounting system was designed for control of nuclear materials at the Hanford Atomic Products Operation. The system uses a 7090 computer in data accumulation, calculation, summarization, and report preparation. The operation of the system and the overall flow of information are described. (D.L.C.)

29813 (SC-DC-64-1034) A STUDY OF IMPACT EFFECTS ON SPHERICAL SHELLS. Quarterly Progress Report No. 2, February 1, 1964–April 1, 1964. Charles E. Stoneking (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station). For Sandia Corp., Albuquerque, N. Mex. Contract AT(29-1)-789. 14p.

The development and construction of the equipment and facility for studying the structural integrity of hollow spheres when they are impacted against a rigid target of known properties are discussed. The development and construction of a ballistic pendulum to be used as a target and for measuring impact pressure are discussed. A theoretical study of wave propagation through elastic media is developed. (N.W.R.)

29814 (NASA-TT-F-90) POST-BUCKLING BEHAVIOR OF CYLINDRICAL SHELLS. PART I. AXIAL COMPRESSION. PART II. EXTERNAL PRESSURE. A. V. Pogorelov. Translation of "Tsilindricheskiye Obolochki pri Zakriticheskikh Deformatsiyakh. I. Osevoye Szhatiye. II. Vneshneye Davleniye." 1962. 160p.

I. An investigation is made of the elastic state of compressed cylindrical shells under conditions of transcritical deformation, with emphasis on the determination of the lower critical load. II. The elastic post-buckling behavior of cylindrical shells acted upon by external pressure is studied with reference to the problem of determination of the lower critical load. (D.L.C.)

29815 ELECTROSTATIC THRUSTORS FOR SPACE PROPULSION, PRESENT AND FUTURE. William R. Mickelsen and Harold R. Kaufman (Lewis Research Center, Cleveland). J. Brit. Interplanet. Soc., 19: 319-37(Mar.-Apr. 1964).

Although some existing electrostatic thrustors have sufficient durability for interplanetary flight, shortcomings of these thrustors would incur serious payload losses. It is shown that these shortcomings are especially severe with regard to programed specific impulse, efficiency, power conversion requirements, and thrustor mass. The detailed status of electrostatic thrustor components is examined on the basis of performance in space missions. The electron-bombardment thrustor appears to be superior to other thrustors. Research programs are then described for electron-bombardment thrustors and contact-ionization thrustors. The critical component in the electron-bombardment thrustor is the cathode; and recent data indicate that durable, low-power cathodes can be developed. The performance of the contact-ionization thrustor is severely limited by porous-tungsten technology. The requirements for sub-micron, close-spaced pores without in-flight-sintering appear formidable. Colloidal-particle thrustors appear to have the best promise for high efficiency at low specific impulse, low mass, and programed specific impulse operation. 82 references. (auth)

29816 PHYSICAL PHENOMENA AND TECHNICAL PROBLEMS OF ARCJET ENGINES. Peter A. Schoeck (Institut für Plasmadynamik, Stuttgart). J. Brit. Interplanet. Soc., 19: 337-49(Mar.-Apr. 1964).

The physical processes occurring during the conversion of electrical power into thrust power in arcjet engines are discussed. These involve the transfer of energy from an electric arc to a gas flow and the conversion of thermal energy into kinetic energy of the jet. The heat transfer from the arc column to the gas is described. The nature of heat transfer losses to the wall and of anode losses is indicated, and cooling methods are investigated. A comparison is made regarding the suitability of various gases and of a number of expansion conditions. The effect of nonuniform heating is discussed. (auth)

29817 WHITHER ADVANCED PROPULSION. R. G. Cruddace (Oxford Univ.). J. Brit. Interplanet. Soc., 19: 361-68(Mar.-Apr. 1964).

The capabilities, relative merits and development requirements of the various types of propulsion systems are surveyed. Electric propulsion is the most promising, but the solid-core fission reactor has an important role to play in early manned missions to the Moon, Mars, and Venus. (auth)

29818 ELASTIC-PLASTIC THERMAL STRESS ANALYSIS OF AN INTERNALLY CLAD TUBE. Bernard W. Shaffer (New York Univ., New York). Nucl. Sci. Eng., 19: 300-9(July 1964).

Thermal stress and displacement equations are derived for an internally clad tube for which the ratio of cladding thickness to internal tube radius is small with respect to unity and in which the cladding and the basic tube have different material properties. When the difference between the cladding temperature and the average temperature of the basic tube is large enough, plastic flow is found to occur in the cladding. The corresponding solution is found by making use of the Tresca yield condition and its associated flow law. The solution is examined to guide the designer in the selection of those cladding material properties that would delay the initiation of plastic flow. (auth)

Applications of Nuclear Explosions

29819 (AWRE-O-7/64) THE EFFECTS OF HIGH-ALTITUDE NUCLEAR EXPLOSIONS ON RADIO COMMUNICATIONS. PART 1. THEORETICAL CONSIDERATIONS. F. L. Hill (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). Mar. 1964. 59p.

The ionization produced in the lower ionosphere by x rays, β particles from neutron decay, and β and γ irradiation from fission products from a nuclear burst is examined and evaluated for a range of burst heights. The effects of this increased ionization are related to the attenuation of r-f signals. The effects of wave motions in the ionosphere are considered. (auth)

29820 (BM-IC-8219) POTENTIAL OF NUCLEAR EXPLOSIVES FOR PRODUCING HYDROCARBONS FROM DEPOSITS OF OIL, NATURAL GAS, OIL SHALE, AND TAR SANDS IN THE UNITED STATES. J. Wade Watkins and C. C. Anderson (Bureau of Mines, Washington, D. C.). Jan. 1964. 24p.

One potential peaceful application of nuclear explosives is stimulating the production of liquid or gaseous hydrocarbons from essentially nonproductive deposits of petroleum, natural gas, oil shale, and tar sands. Within the United States the appreciable difference between producible proved reserves and ultimate reserves and resources of hydrocarbon deposits is of such magnitude that much petroleum, natural gas, shale oil, and bitumen will not be produced unless significant technological progress is made in production techniques. The shattering effect of contained nuclear explosives and, to a lesser extent, the heat produced, have been considered as stimulative forces when the thickness, depth, and nature of such deposits permit considering the use of nuclear devices. Mechanical production problems would be less in an oil or gas reservoir than in an oil-shale or tar-sands deposit. Also, tar-sands resources in the United States may not be adequate to warrant serious consideration of applying nuclear-explosives stimulation. Gas reservoirs should present the least-radioactive-contamination problem. The technical feasibility of using nuclear explosives cannot be evaluated fully at present. Additional information is needed on the effects of pressure, heat, and radioactivity on the solids and fluids of hydrocarbon deposits, the nature and extent of induced fractures in different rock media, and the possibility of isolating and confining or removing radioactive contaminants. Final technical feasibility can only be determined by a field test. If technical feasibility is established, economic feasibility will depend upon the comparative cost of producing hydrocarbons by nuclear explosives and by conventional means. It is probable that an economic comparison would favor nuclear stimulation only where devices of relatively high yield could be used practicably and safely. (auth)

29821 (BM-RI-6494) A STUDY OF THE FEASIBILITY OF USING NUCLEAR EXPLOSIONS TO INCREASE PETROLEUM RECOVERY. Charles H. Atkinson and Robert T. Johansen (Bureau of Mines. Bartlesville Petroleum Research Center, Okla). Jan. 1964. 20p.

Tremendous volumes of petroleum (crude oil and natural gas) at present cannot be recovered economically. The feasibility of using nuclear explosions for production stimulation therefore has been investigated. Data from underground nuclear tests conducted by the Atomic Energy Commission were reviewed, and the physical effects were evaluated for stimulating petroleum production. Calculations of the effect on ultimate recovery of increasing reservoir temperature with nuclear explosives showed disappointingly small increases. Production increases caused by fracturing of massive low-permeability reservoirs appear technically and economically promising. Petroleum reservoirs that might be converted from submarginal to commercial production are being located and evaluated as to potential reserves and as a location for a field test. (auth)

29822 (LA-3064) THEORY OF THE FIREBALL. Hans A. Bethe (Los Alamos Scientific Lab., N. Mex.). Feb. 1964. Contract W-7405-eng-36. 85p.

The successive stages of the fireball due to a nuclear explosion in air are defined; chief concern is with Stage C, from the minimum in the apparent fireball temperature to the point where the fireball becomes transparent. In the first part of this stage (C I), the shock, which previously was opaque, becomes transparent due to decreasing pressure. The radiation comes from a region in which the temperature distribution is given essentially by the Taylor solution; the radiating layer is given by the condition that the mean free path is about $1/50$ of the radius. The radiating temperature during this stage increases about as $p^{-1/4}$, where p is the pressure. To supply the energy for the radiation, a cooling wave proceeds from the outside into the hot interior. When this wave reaches the isothermal sphere, the temperature is close to its second maximum.

Thereafter, the character of the solution changes; it is now dominated by the cooling wave (Stage C II). The temperature would decrease slowly (as $p^{1/4}$) if the problem were one-dimensional, but in fact it is probably nearly constant for the three-dimensional case. The radiating surface shrinks slowly. The cooling wave eats into the isothermal sphere until this is completely used up. The inner part of the isothermal sphere, i.e., the part that has not yet been reached by the cooling wave, continues to expand adiabatically; it therefore cools very slowly and remains opaque. After the entire isothermal sphere is used up, the fireball becomes transparent and the radiation drops rapidly. The ball will therefore be left at a rather high temperature, about 5000°. The cooling wave reaches the isothermal sphere at a definite pressure $p_c \approx 5(\rho_1/\rho_0)^{1/3}$ bars, where ρ_1 is the ambient and ρ_0 the sea level density. The radiating temperature at this time is about 10,000°. The slight dependence of physical properties on yield is exhibited in approximate formulas. (auth)

29823 (RM-3932-PR) EFFECTS OF NEUTRONS FROM HIGH-ALTITUDE DETONATIONS. P. Tamarkin (RAND Corp., Santa Monica, Calif.). Nov. 1963. Contract AF49(638)-700. 13p. (AD-428158)

Consequences of the decay of neutrons from high-altitude nuclear detonations in equatorial regions are examined. Sample temporal variations of night-time D-layer ionization profiles resulting from direct precipitation of neutron-decay betas are presented for pure fission and for 1-kev thermal source-neutron spectra. There are large differences, between the two cases, in the maximum amount of ionization produced and number of seconds required to attain maximum ionization. These differences emphasize the need to consider actual spectra of neutrons from high-altitude detonations in the study of the vlf propagation anomalies they produce. Under certain stated conditions the energetic protons from the decay of similarly energetic neutrons can cause more D-layer ionization than do the decay betas, with especial consequences for affecting vlf propagation over day-lit paths. A similar comparison for 12 to 14 Mev trapped protons leads to the conclusion that 10^{25} neutrons set free with energies between 12 and 14 Mev would produce a differential directional flux equal to that measured in the region near L = 2.5. (auth)

29824 (WT-1834) THE DEFINITION OF TRUE CRATER DIMENSIONS BY POST-SHOT DRILLING. Nicholas M. Short (California. Univ., Livermore. Lawrence Radiation Lab.). Mar. 2, 1964. Project DANNY BOY. Contract W-7405-eng-48. 59p.

The Danny Boy event of March 5, 1962, was a nuclear cratering explosion of 0.42-kt yield at a depth of 110 ft in a basalt flow capping Buckboard Mesa in Area 18, Nevada Test Site. In May–June 1962, three slant holes were drilled from the northwest side of the crater lip base into the vicinity of the shot point for purposes of recovering samples for radiochemical yield determination, assessing the fracture state in the inelastic zone, and locating the true crater surface at several points in order to estimate the explosion cavity radius at the time of venting. Percent core recovery data and radiation logs failed to define the fallback-true crater interface nor was any radioactive glass lining the cavity surface found in the cores. Rock in a 2-ft-thick zone immediately beyond this surface was intensely crushed and fractured in a manner readily discernible by a petrographic microscope examination. Core samples from all three holes examined thusly over 1-ft intervals revealed these microfractures to occur consistently at points 35 to 38 ft radially from the shot point. A radius of 36 ± 2 feet is therefore assigned to the explosion cavity. The true crater (cavity) surface is a hemisphere radially symmetrical about the shot point at depths below approximately 110 ft. Fixing this radius relative to calculated cavity expansion curves and to the probable time of venting aids in the understanding of history and mechanisms of cavity growth, from which speculative treatments of the behavior of rock and water vapors in the growing cavity and of a possible origin of vesiculated glass found in the crater throwout rubble have been developed. (auth)

Facilities and Equipment

29825 (NP-14044) EFFECT OF IMPURITIES OF CESIUM FUEL UPON ION ENGINES. Monthly Progress Report, April 1964. B. A. Free and J. W. Carter (General Electric Co. Missile and Space Div., Cincinnati). Contract AF33(657)-9163. 9p.

The performance of pure Cs–0.3% Na mixtures in ion engines is measured as a function of temperature. (T.F.H.)

29826 (UCRL-7358-T) SIMPLE, COMPACT, CONTROLLED-RECTIFIER ACCESSORY UNIT OPENS NEW USES FOR ELECTRIC HAND DRILLS. Robert Lenz (California. Univ., Livermore. Lawrence Radiation Lab.). [nd]. Contract W-7405-eng-48. 6p.

Silicon controlled rectifiers now make possible speed control with high torque at low speeds for small a-c–d-c motors. A silicon controlled rectifier speed control was built for a $\frac{3}{8}$-inch, 3-amp electric hand drill in a small housing that plugs in between the a-c outlet and the drill power cord. A double-pole, double throw push button reversing switch was added to the drill handle. This combination (reversing switch and speed control) triples the drill's uses. (auth)

29827 (UCRL-7829) VORTEX TUBES, A BIBLIOGRAPHY. Brigitta M. Dobratz (California. Univ., Livermore. Lawrence Radiation Lab.). Apr. 1964. Contract W-7405-eng-48. 21p.

A total of 101 references covering the years from 1950 to 1963 is presented on vortex tubes as cooling devices; their construction, application, and operation; and theoretical aspects of the Ranque-Hilsch effect. An author index is included. (D.L.C.)

29828 (AEC-tr-6231(p.359-66)) RESEARCH REPORTS FROM THE TOKYO RESEARCH INSTITUTE. Co-60 GAMMA-RAY IRRADIATION EQUIPMENT AT THE TOKYO RESEARCH INSTITUTE. Kenichi Shigehara and Tomomichi Shegematsu. (Translation)

A description is given of the 1000-c ^{60}Co irradiation equipment which is of the double cavity type. The radiation source and irradiation chamber are described. The dose rate and its distribution in the equipment are given. Safety devices and precautions are discussed. (D.L.C.)

29829 ELECTRON GUN FOR DETERMINING THE EVAPORATION SPEED OF DIFFICULTLY VOLATILIZED MATERIALS. G. P. Kovtun, A. A. Kruglykh, and V. S. Pavlov (Inst. of Physics and Tech., Academy of Sciences Ukrainian SSR). Pribory i Tekhn. Eksperim., No. 2, 130-2(Mar.-Apr. 1964). (In Russian)

An electron gun for determining the evaporation speed of difficultly volatilized materials in the solid state at high temperatures is described. The maximum temperature of 3000°C is obtained for samples of graphite and tungsten. (tr-auth)

29830 PRECESSION CAMERA FOR PHOTOGRAPHING RECIPROCAL LATTICES. L. A. Feigin, A. V. Mirenskii,

and G. D. Shnyrev (Inst. of Crystallography, Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 2, 156-60(Mar.-Apr. 1964). (In Russian)

The design and performance of a precession camera for photographing reciprocal lattices are discussed. An outline of the method, the advantages, and the possibilities of the precession method of x-ray photography is presented. (tr-auth)

29831 MODERNIZATION OF THE CAMERA RKSO FOR DIFFRACTION X-RAY MICROGRAPHS. V. G. Fomin, M. A. Gurevich, and E. M. Sonkina (State Research Inst. for Rare Metals, USSR). Pribory i Tekhn. Eksperim., No. 2, 160-2(Mar.-Apr. 1964). (In Russian)

The modernization of RKSO is discussed. The introduction of a goniometric attachment, a slotted device, and a Geiger counter adapts the camera for x-ray micrographs. (tr-auth)

29832 GRAPHITE HEATER FOR MHD STUDIES. J. Klepeis (Avco-Everett Research Lab., Everett, Mass.). Rev. Sci. Instr., 35: 846-7(July 1964).

A graphite heater is described that was constructed to study magnetohydrodynamic generator performance at high values of the Hall coefficient (10 to 15). The heater can produce an intermittent, uniform flow of argon having a stagnation temperature of 2000°K and stagnation pressure of 5 psig for a time duration of approximately 30 sec. Its main component is a core of 1400 graphite rods, $\frac{3}{8}$ in. in diameter and 24 in. long, stacked vertically within a hollow graphite cylinder 16 in. in diameter. This core is heated to 2000°K by radiation from graphite resistors. Argon is passed through the spaces between the core rods and heated convectively to the core temperature. The gas flow is made electrically conductive by mixing with an easily ionizable seed material. (auth)

Heat Transfer and Fluid Flow

29833 (AEEW-R-330) DESIGN AND OPERATION OF A TRANSISTORISED BRIDGE-TYPE DETECTOR FOR BURN-OUT IN BOILING HEAT TRANSFER EXPERIMENTS. K. J. Salt and C. A. Wintle (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Apr. 1964. 18p.

Theoretical, technical, and operational details are given of an instrument to protect heater rods in heat transfer burnout experiments from actual rupture under electrical heating, by a Wheatstone bridge method. (auth)

29834 (AEEW-R-373) IDENTIFICATION OF SOME CROSS FLOW HEAT EXCHANGER DYNAMIC RESPONSES BY MEASUREMENT WITH LOW LEVEL BINARY PSEUDO-RANDOM INPUT SIGNALS. E. R. Corran, J. D. Cummins, and A. Hopkinson (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Feb. 1964. 38p.

An experiment was performed to assess the usefulness of the binary cross-correlation method in the context of the identification problem. An auxiliary burner was excited with a discrete interval binary code and the response to the perturbation of the input heat was observed by recording the variations of the primary inlet, primary outlet, and secondary outlet temperatures. The observations were analyzed to yield cross-correlation functions and frequency responses were subsequently determined between primary inlet and primary outlet temperatures and also between primary inlet and secondary outlet temperatures. The analysis verified (1) that these dynamic responses of this cross flow heat exchanger may be predicted theoretically, and (2) insofar as this heat exchanger is representative of the generality of plant, that the binary cross-correlation method provides adequate identification of plant dynamics for control purposes in environments where small input variations and low signal to noise ratio are obligatory. (auth)

29835 (BAW-3238-3) NON-UNIFORM HEAT GENERATION EXPERIMENTAL PROGRAM. Quarterly Progress Report No. 3, January–March 1964. D. F. Judd, R. H. Wilson (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.); H. S. Swenson, R. A. Lee, and J. W. Ackerman (Babcock and Wilcox Co. Research Center, Alliance, Ohio). Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(30-1)-3238. 10p. (EURAEC-1072)

The effects of irregular heat flow through reactor channels are discussed. Tubular specimens having four axial power shapes and annular specimens having five power shapes will be used, and an effort to correlate the experimental data with empirical and analytical models will be made. The instrumentation, bus bars, piping, and Test Section No. 1 are complete for the first test and installed except for the final connections, which will be made when the loop is shut down. (auth)

29836 (CEA-R-2422) ECHANGES DE CHALEUR TRANSVERSAUX DANS UN CANAL RECTANGULAIRE CHAUFFE NON UNIFORMEMENT. APPLICATION AU CALCUL DES TEMPERATURES DANS UNE CELLULE DU REACTEUR SILOE. (Transversal Heat Exchange in a Rectangular Channel Heated Non-Uniformly. Application to the Calculation of Temperatures in a Cell of the Reactor SILOE). Claude Lackme (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Grenoble). Apr. 1964. 47p.

In the techniques used for cooling reactors, the existence of flux peaks is a great nuisance. The case is considered of a fuel lattice made up of plates and thus giving rectangular cooling channels. A theoretical and practical study was made of transversal heat exchange in this structure. An example is given of an application, which is in the form of a calculation of the temperature distributions at the exit of a cooling channel of the swimming-pool type reactor SILOE operating at 10 Mw. (auth)

29837 (GEAP-4492) TRANSITION AND FILM BOILING DATA AT 600, 1000, AND 1400 PSIA IN FORCED CONVECTION HEAT TRANSFER TO WATER. J. E. Hench (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Feb. 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(04-3)-189. 71p. (EURAEC-1083)

A study was undertaken to determine the feasibility of operation beyond the critical heat flux and to determine the severity of conditions when operating near or beyond the critical heat flux. Experimental data were obtained beyond the critical heat flux in the transition and film boiling regime of forced convection heat transfer to water at 600, 1000, and 1400 psia. The range of steam quality at the two-rod test section exit is from 20 to 100 percent. The mass velocities are 0.5, 1.0, 1.4, and 1.95 Mlb/hr-ft^2. The data obtained indicate that for appropriate values of mass velocity and steam quality, operation beyond the critical heat flux in forced convection heat transfer is possible using standard commercially available materials. (auth)

29838 (HW-80535) STEAM–WATER CRITICAL FLOW FROM HIGH-PRESSURE SYSTEMS. Interim Report. F. R.

Zaloudek (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 1964. Contract AT (45-1)-1350. 23p.

The critical discharge of steam-water mixtures from a short piece of pipe (length/diameter = 20) was studied at upstream pressures approaching 2000 psia. The pipe was 0.505 in. in diameter and had a 20° conical approach section. Inlet enthalpies of approximately 425, 460, 485, and 530 Btu/lb were considered. When a two-phase mixture entered the test section, flow-choking conditions occurred at the end of the test section, and the data demonstrated good correspondence with the predictions of the Fauske critical flow theory. When compressed water entered the pipe and was required to flash to a steam-water mixture in the length of the pipe or in the conical approach section, the location of primary choking was at the entrance of the pipe rather than at the exit where it is normally assumed to exist. Flow rates were considerably greater than predicted by the Fauske theory based upon corresponding exit conditions. During the existence of upstream choking, the pressure at the entrance of the pipe remained at the saturation value regardless of flow rate. The data were correlated by the following equation with maximum deviation of 10%: $G = C\sqrt{|2g/v_f|\,(P_{up} - P_{sat})}$ ($400 < P_{up} < 1800$ psia), where G = mass velocity during upstream choking; P_{up} = upstream pressure; P_{sat} = saturation pressure; v_f = specific volume of saturated water; and C = 0.95. This upstream choking was similar to the choking phenomenon observed in an earlier investigation in which very short tubes were considered at lower temperatures and pressures than used in the present study. (auth)

29839 (NAA-SR-8906) HEAT TRANSFER AND VOID FORMATION DURING FORCED CIRCULATION BOILING OF ORGANIC COOLANTS. F. Bergonzoli and F. J. Halfen (Atomics International, Div. of North American Aviation, Inc., Canoga Park, Calif.). June 15, 1964. Contract AT-11-1-GEN-8. 57p.

The experimental results of an extensive parameter survey are reported for forced circulation boiling of organic coolants. The observed effect of dissolved gas on the onset of nucleate boiling and on the overall heat transfer behavior of boiling organic coolants is discussed. The boiling heat transfer and void fraction results for degassed coolants are correlated by existing models or modifications of existing models whenever possible. A model is presented for the correlation of the void fraction data at or near saturation conditions. The possibility of application of this model to other systems and geometries is explored. The effect of system pressure and quality on the slip ratio of organic coolant vapor is illustrated. The tests were conducted in a closed circulation loop at iow system pressures (1 to 2 atmospheres). A d-c resistance heated test section consisting of a vertical, seamless nickel tube of $^{9}/_{16}$ in. OD with a 0.042 in. wall thickness and having a heated length of 12 ft was used in these experiments. (auth)

29840 (NYO-2404-3) EFFECTS OF ELECTRICAL FIELDS ON BOILING HEAT TRANSFER. Quarterly Progress Report, November 25, 1963–February 25, 1964. Robert L. Durfee and Charles R. Nichols (Atlantic Research Nuclear Corp., Alexandria, Va.). Contract AT(30-1)-2404. 9p.

The development of a heat transfer loop and its components for studying the effects of applied electrostatic fields on the boiling of water on an electrically heated surface at elevated pressures is discussed. Boiling will be induced by electrical resistance heating of the central wall of a vertical annular flow channel. Electrostatic fields will be applied across this annular flow gap. The efficiency of the plant and the variations of the power advantage factor are evaluated theoretically. (N.W.R.)

29841 (NYO-2930-4) AN EXPLORATORY STUDY OF THE HEAT-TRANSFER CHARACTERISTICS FOR A NON-NEWTONIAN, NON-FOURIER FLUID. Technical Report No. 104-ME-H. C. F. Chen (Rutgers Univ., New Brunswick, N. J.). May 1964. Contract AT(30-1)-2930. 18p.

The Graetz-Nusselt problem is considered for a non-Newtonian and non-Fourier fluid. The heat flux is assumed to be primarily linear in the gradient of temperature, with a small correction term that is proportional to the square of the temperature gradient. A linear perturbation method is used. For a plug flow, the formal solution of the first-order problem was obtained. Away from the thermal entrance region, a simple, approximate solution was obtained. Numerical values of temperature distribution and Nusselt number were calculated. (auth)

29842 (NYO-2974-1) THE FLOW STABILITY OF GAS-SOLIDS SUSPENSIONS. Final Report. G. P. Wachtell and J. P. Waggener (Franklin Inst. Labs. for Research and Development, Philadelphia). Feb. 1964. Contract AT(30-1)-2974. 141p.

One of the principal purposes of the work reported was to study the stability of gas solid suspensions in the presence of a thermal gradient. Previously reported experience with unstable suspensions is summarized. A gas-solid centrifugal circulator, suitable for operation at a temperature of 600°F or greater and at 10 or more atmospheres of pressure, was designed and built. This compressor utilizes a buffered gas pressure seal and standard grease packed ball bearings. It is installed in a closed loop having an absolute minimum of lubricant vapor contamination. The circulator and the associated closed loop equipment are described. The equipment includes an AEC gas-graphite densitometer, which utilizes two promethium-147 radiation sources. A study was conducted to investigate the suitability of a number of materials that may find application as the particulate matter of a gas-solid suspension from the standpoint of coolant activation and the concomitant need for radiation shielding of the cooling stream. A probe was developed to detect the accumulation and removal of graphite at a flow boundary surface. A basis for predicting the advent of suspension instability in the form of deposition at the cold wall of a heat exchanger was developed. This approach uses a simple model of shear stress at the wall and the force on the particle due to a thermal gradient at the wall. Preliminary observations of deposition and removal of graphite in carbon dioxide gas were obtained, which encourage the use of the shear force–thermal force model as a basis for predicting the flow conditions necessary to maintain a stable gas-solids suspension. Other theoretical developments relate to the effect of turbulence in promoting removal of deposited graphite. Appendices include activation of coolant stream, a listing of particle supply sources, an annotated bibliography of gas-solids suspensions, and criterial equations of convective heat exchange in the two-phase flows of the gas-mixture type. A separate abstract was prepared for the latter section on convective heat exchange. (auth)

For an abstract of the individual item see: 29849.

29843 (ORNL-3619(p.336-58)) EXPERIMENTAL INVESTIGATIONS OF HEAT TRANSFER AND FLUID FLOW. H. W. Hoffman (Oak Ridge National Lab., Tenn.).

Experimental investigations of the thermal-hydraulic

characteristics of gas-cooled reactors fueled with packed beds of fuel spheres are carried out on full- and reduced-scale models. (T.F.H.)

29844 (SAN-409-1) HIGH ACCELERATION FIELD HEAT TRANSFER FOR AUXILIARY SPACE NUCLEAR POWER SYSTEMS. Quarterly Technical Report, December 1, 1963–February 29, 1964. H. F. Poppendiek, N. D. Greene, C. M. Sabin, R. K. Livett, F. R. MacDonald, and L. V. Feigenbutz (Geoscience Ltd., Solana Beach, Calif.). Contract AT(04-3)-309. 30p. (GLR-21)

The results of forced-flow boiling mercury heat transfer and pressure drop measurements for linear and helical flow in a Haynes 25 alloy boiler tube are presented as functions of flow rate, vapor quality, and pressure. The experimental local conductance and frictional pressure drop data are also compared with analytical predictions. Significant improvements in heat transfer and exit vapor quality were demonstrated for helical flow boiling. Mercury droplet vaporization lifetime experiments have been completed. The mercury lifetime measurements, as well as experimental data for benzene, were found to be in general agreement with theory when vaporization occurs in the film boiling regime. A photographic description of drop vaporization in the nucleate boiling regime (prior to film boiling) is given. Potassium droplet vaporization experiments have been initiated. The low-pressure Haynes 25 alloy forced-flow boiling potassium system is nearly completed. The component assembly, dynamic performance characteristics of the system using water, and the parameter range to be investigated in the coming experiments are described. Some calculations of thermodynamic and transport properties of alkali metal vapors are being performed in support of heat and momentum transfer evaluation and generalization. (auth)

29845 (TID-20664) BASIC STUDIES IN GAS-SOLID SUSPENSION. Quarterly Report No. 64-1, January 1, 1964–April 1, 1964. Richard L. Peskin (Rutgers Univ., New Brunswick, N. J. Coll. of Engineering). Apr. 24, 1964. Contract AT(30-1)-2930. 15p.

A research program is being conducted on the fluid mechanics and heat transfer in turbulent gas-solid suspensions. A summary is presented of: equipment construction for heat transfer experiments, instrumentation (mass flux meter and anemometer), mass transfer experiments, and theoretical analysis of heat transfer and flow. (D.L.C.)

29846 (AEC-tr-6431) HEAT TRANSFER DURING THE CONDENSATION OF HIGH-PRESSURE STEAM IN PIPES. Z. L. Miropol'skii. Translated for Westinghouse Electric Corp., Bettis Atomic Power Lab., Pittsburgh, from Teploenerg., 9: No. 3, 79-83(1962). 13p.

Results are presented of an experimental determination of local values of the heat transfer coefficient for water, a steam-water mixture, and superheat steam moving in cooled tubes at pressures of 7 to 220 abs. atm., mass flow rates of 400 to 2,000 $kg/m^2 \cdot sec$, and unit heat flux rates of 0.15 to 5 million $kcal/m^2 \cdot hr$. (auth)

29847 (EURAEC-922) HEAT TRANSFER IMPROVEMENT IN BOILING WATER REACTORS. Quarterly Report No. 15, October–December 1963. (Societe Nationale d'Etude et de Construction de Moteurs d'Aviation. Division Atomiques, Suresnes, France). Jan. 13, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 058-61-7 RDF. 11p. (A translation)

Research on hydrodynamic characteristics, high-pressure thermal testing, and a model reactor core is reported, with application to the improvement of heat transfer in boiling-water reactors. (T.F.H.)

29848 (EURAEC-1026) INVESTIGATION OF THE CRITICAL BURNOUT WITH BOILING WATER. Quarterly Report No. 10, January 1–March 31, 1964. W. H. Agena (Maschinenfabrik Augsburg-Nurnberg A. G., Nuremberg). Apr. 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 057-61-RDD. 11p. (A translation)

The second test section was equipped with instruments and connected into the test circuit. The behavior of the equipment in service was examined. The seal at the lid of the steam separator leaks. The construction of a third test section was started. The connection of the electronic gear for measuring the volumes of flow by means of turbine flow meters was tested and the calibration of these instruments was prepared for axial sections of the test tubes. The theoretical analysis of a calculating process for the axial distribution of pressure, void volume, slip, and special flow parameters in a heated flow channel was continued. An investigation was made on the convergence of the digital computer programs developed for analyzing relations in critical burnout. (auth)

29849 (NYO-2974-1(p.D1-22)) CRITERIAL EQUATIONS OF CONVECTIVE HEAT EXCHANGE IN THE TWO-PHASE FLOWS OF THE GAS-MIXTURE TYPE. Z. R. Gorbis (Franklin Inst. Labs. for Research and Development, Philadelphia).

Translated from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk, No. 9, 94-102(Sept. 1958.

The equations of continuity, fluid motion in a two-phase flow, motion of the solid phase, energy in the two-phase system, hydromechanics of two-phase flow, and heat transfer in a gas-solid mixture are presented. Numerical presentation of the equations is discussed. (R.E.U.)

29850 (ORNL-tr-107) CRITICAL HEAT LOADS IN HIGH-PRESSURE BOILING OF UNDERHEATED WATER IN SMALL DIAMETER TUBES. A. P. Ornatskii and A. M. Kichigin. Translated by A. L. Monks (Oak Ridge National Lab., Tenn.), from Teploenerg., 9: No. 6, 44-7(1962). 6p.

The dependence of critical heat load on mass flow rate, underheating, and pressure when water is forced to flow in a 2-mm-dia tube is given. An experimental equation to determine q_{cr} is proposed, and a comparison with other data is given. (auth)

29851 (UCRL-Trans-1012(L)) DIFFERENCE METHODS OF NUMERICAL SOLUTION OF PROBLEM OF GAS DYNAMICS. S. K. Godunov and K. A. Semondyaev. Translated by Sergey Shewchuck (Univ. of California Lawrence Radiation Lab., Livermore), from Zh. Vychislitel. Mat. i Mat. Fiz., 2: 3-14(1962). 23p.

Mathematical methods in gas dynamics are reviewed, and their general characteristics and applications are discussed. Theorems of existence, the method of characteristics, difference schemes, choice of variables, existence of a general solution, character of convergence, many-dimensional problems, and problems of equation of state are considered. (R.E.U.)

29852 CONVERGENCE IMPROVEMENT METHODS IN ONE-DIMENSIONAL THERMAL CONDUCTIVITY AND DIFFUSION PROBLEMS. RESEARCH OF THE INITIAL PHASE. Kurt Uhde (Brown Boveri/Krupp Reaktorbau GmbH, Mannheim, Ger.). Atomkernenergie, 9: 153-8 (May-June 1964). (In German)

Normally thermal conductivity and diffusion problems are solved by means of Fourier's method. Such a solution

then, in general, is given by an infinite series, the convergence of which for small values of $\alpha^2 t$, the so called initial phase, with α^2 as the thermal conductivity or diffusion constant, is so poor that the numerical evaluation becomes difficult. This initial phase, however, is spread over a large period in the case of small values of α^2, and is therefore important, because, in this case, any experimental measurements do not exceed this initial phase. These series of poor convergence in the initial phase were therefore transformed by means of ϑ functions into a different representation of convergence for the initial phase, so that the behavior during this period can easily be calculated. It also became possible to study, in a direct way, the influence of the boundary condition characterizing the transfer conditions to the bordering medium. (auth)

29853 QUALITATIVE REMARKS ON THE NATURE OF THE HEAT TRANSFER CRISIS WITH STEAM–WATER MIXTURES. S. Bertoletti, C. Lomgardi, and G. Peterlongo (CISE, Milan). Energia Nucl. (Milan), 11: 269-72(May 1964).

The problem of film disruption crisis in annular dispersed flow is clarified. Physical hypotheses, which emphasize the system parameters directly influencing this phenomenon, are discussed. The case of vertical heated sections having a constant cross section, without transverse obstacles, and cooled by a steam–water mixture flowing upwards in forced convection is considered. (M.J.T.)

29854 THE HIGH TEMPERATURE ASPECTS OF HYPERSONIC FLOW. Proceedings of the AGARD-NATO Specialists' Meeting, Belgium, 3-6 April, 1962. Wilbur C. Nelson, ed. Oxford, Pergamon Press, 1964. 795p. £15. (AGARDograph 68)

Thirty-six papers are included. Abstracts were prepared for 3 papers. Three papers were previously abstracted for NSA; see abstracts 16: 32235, 32476; 17: 14923. (L.B.S.)

For abstracts of individual papers see: 29855, 20928, and 30929.

29855 THE PROBLEM OF IONIZATIONAL RELAXATION FOR MODERATELY STRONG SHOCKS IN MONATOMIC GASES. D. G. H. Frood (Royal Armament Research and Development Establishment, Fort Halstead, Kent, Eng.). p.485-500 of "The High Temperature Aspects of Hypersonic Flow." Oxford, Pergamon Press, 1964.

The essential physical problems and conceptual difficulties associated with the development of a satisfactory theory to account for the observed rate of approach to ionization equilibrium behind shocks in monatomic gases are discussed. The possibility that the production mechanism for initial ionization is due to a few, free electrons which always exist inherently in the undisturbed region ahead of the shock and which, after crossing the shock front, become capable of initiating the ionization process is developed. A collective mechanism is also introduced to give insight into the theory of the structure of ionizing shocks. (L.B.S.)

Materials Testing

Refer also to abstracts 30265 and 31028.

29856 THE DEVELOPMENT AND OPERATIONAL CHARACTERISTICS OF A UNIQUE COMBINED ENVIRONMENT SPACE SIMULATOR. K. G. Young, Jr., and M. I. Gamble. p.577-82 of "Institute of Environmental Sciences, 1964 Proceedings." Mt. Prospect, Ill., Institute of Environmental Sciences, 1964.

A system is described for simultaneously exposing a sample to electromagnetic (0.1 to 4 microns) and particulate radiation, while maintaining a vacuum in the 10^{-10} torr range. A Van de Graaff accelerator provides electrons, protons, and alpha particles with energies of 10 kev to 0.5 Mev, and with appropriate ions and targets can give appropriate neutron energies and fluxes. A rather wide temperature range is also provided. (D.C.W.)

29857 THE SIMULATION OF SPACE RADIATIONS BY DC PARTICLE ACCELERATORS. E. Alfred Burrill (High Voltage Engineering Corp., Burlington, Mass.). p.673-9 of "Institute of Environmental Sciences, 1964 Proceedings." Mt. Prospect, Ill., Institute of Environmental Sciences, 1964.

The characteristics and suitability of the radiation sources generally used to synthesize space radiations are reviewed. The versatility of d-c accelerators is stressed by considering their suitability for heavy ion acceleration, micrometeoroid simulation, and production of various intensities and pulsed radiations. (D.C.W.)

Protective Structures

29858 (AD-428009) STUDY OF SHOCK ISOLATION METHODS FOR CIVIL DEFENSE SHELTERS. (Ammann and Whitney, New York). Nov. 1963. Contract DA 49-129-eng-506. 357p.

Results are presented of a study devoted to the establishment of basic criteria and shock isolation techniques applicable to hardened civil defense shelters for protection of personnel and equipment against ground shock effects from nuclear weapons. The report includes a comprehensive review of the state of the art covering background information from which are established ground-shock input data and shock spectra, personnel and equipment shock tolerance criteria, and appropriate shock-isolation methods. General shock isolation schemes, including spring systems and cushioning materials, are evaluated. Design examples and cost estimates of specific shock isolation systems are presented and discussed for shallow-buried structures with populations of 10, 100, and 250 persons at the 25-, 100-, and 300-psi blast overpressure levels for a 20-MT surface burst. Recommendations for further study are given. (auth)

29859 (AD-429134) STRUCTURAL MATERIALS FOR HARDENED PERSONNEL SHELTERS. Final Report. John A. Havers (Illinois Inst. of Tech., Chicago. IIT Research Inst.). Dec. 1963. Contract OCD-OS-62-66. 599p.

Structural materials are evaluated for use in fully-buried personnel shelters, located above the ground water table. Analytical relationships are supplied for the structural elements of these shelters, assuming shelter configurations of a rectangular cubicle, a horizontal 180 degree arch and full cylinder, and a 180 degree dome and full sphere. In-place costs are derived for suitable structural materials, and cost equations are supplied for estimating the in-place cost of structural elements. Various structural units are used in preparing alternative designs for a 100-man capacity shelter in the 10 to 200 psi over-pressure region. Cost trends are indicated, and minimum structural costs are related to design level of overpressure. (auth)

29860 (AD-430603) GAMMA-RAY STREAMING THROUGH DUCTS. C. M. Huddleston and W. L. Wilcox-

son (Naval Civil Engineering Lab., Port Hueneme, Calif.). Feb. 6, 1964. 45p.

A survey is presented of the current status of experimental and theoretical investigations of the problem of gamma streaming through air ducts in concrete. Data are tabulated and plotted for a variety of experiments. Comparisons are made between theory and experiment, inconsistencies are pointed out, and areas needing further investigation are indicated. (auth)

Vacuum Engineering

Refer also to abstract 29954.

29861 (WERL-9) ULTRAHIGH VACUUM TECHNIQUES. Annual Report, January 1–December 31, 1963. Research Report 64-928-441-R2. D. W. Feldman, W. J. Lange, M. Rabinowitz, J. H. Singleton, and R. J. Zollweg (Westinghouse Electric Corp. Research Labs., Pittsburgh). Feb. 26, 1964. Contract AT(30-1)-2823. 38p.

The development of electron sources, high-sensitivity mass spectrometers, and Teflon coatings for walls of ultrahigh vacuum systems is discussed. Photodesorption, thermal desorption, electron reflection by metal surfaces, and inelastic collisions of electrons at surfaces are discussed. The effects of residual gases (CO_2, CO, and H) and the evolution of CO from tungsten surfaces on the attainment of ultrahigh vacua were studied. (R.E.U.)

29862 ION BOMBARDMENT INDUCED EMISSION OF SORBED GAS FROM GLASS SURFACES. L. H. James, J. H. Leck, and G. Carter. Brit. J. Appl. Phys., 15: 681-9(June 1964).

Inert gas ions were pumped into glass surfaces, and their release by bombardment with a second inert gas ion species was observed. The rates of release and percentage of sorbed gas recoverable were observed for all combinations of helium, neon, argon, krypton, and xenon as the sorbed or releasing gas; effective self sputtering coefficients for each gas were deduced. These latter were observed to be considerably greater than unity. Thus it is deduced that gas release is effected by energy transfer to the trapped gas from the bombarding ion rather than by sputtering of the glass. The mechanism of gas trapping is investigated in terms of radiation damage and ion penetration concepts. (auth)

29863 MAGNETIC ELECTRIC DISCHARGE PUMP WITH COLD CATHODE (REVIEW). Yu. A. Karpov, E. I. Kontor, O. N. Talenskii (Inst. of Metallurgy, USSR). Pribory i Tekhn. Eksperim., No. 2, 5-16(Mar.-Apr. 1964). (In Russian)

A review is given of the design, construction, performance, and applications of cold cathode gas discharge tubes using a magnetic field (Penning discharge) for use in vacuum technology. (C.E.S.)

29864 PSEUDOWINDOW FOR USE IN PRODUCTION OF SOFT ULTRAHIGH VACUUM WITH VACUUM ULTRAVIOLET AND SOFT X-RAY MONOCHROMATORS. Norman N. Axelrod (Univ. of Delaware, Newark). Rev. Sci. Instr., 35: 918-19(July 1964)

The use of a thin film that acts as a mechanical window for pressure differences between the main chamber and the experimental chamber in ultrahigh vacuum systems in vacuum ultraviolet spectroscopy is discussed. (C.E.S.)

29865 VACUUM TECHNOLOGY. Andrew Guthrie. New York, John Wiley and Sons, Inc., 1963. 542p. $12.50.

The characteristics of vacuum and vacuum systems are studied. Information is given on rotary oil-sealed, vapor, and other types of pumps; measurement of pressure and pumping speed; vacuum materials and some of their cleaning and fabrication techniques; baffles, valves, traps, and other vacuum components; conventional, very-high, and ultra-high vacuum systems; and the detection and repairing of leaks. (T.F.H.)

GEOLOGY AND MINERALOGY

General

29866 (UCRL-7803) POSTSHOT GEOLOGIC INVESTIGATIONS OF THE DANNY BOY NUCLEAR CRATERING EXPERIMENT IN BASALT. Joseph F. Leisek (California. Univ., Livermore. Lawrence Radiation Lab.). Mar. 13, 1964. Contract W-7405-eng-48. 31p.

In March 1962 a low-yield nuclear event code-named Danny Boy was detonated in a basalt medium at the Nevada Test Site. The explosion created a visible crater 250 to 280 feet across and approximately 90 feet deep, with an approximate volume of 52,000 cubic yards. The apparent crater (the portion of the visible crater below original ground level) has a radius of 102 to 115 feet, a depth of 64 feet, and a volume of approximately 33,500 cubic yards. Because of the rock type, the experiment lends itself to practical application in many mining and construction situations. This report describes the Danny Boy crater geology in some detail. (auth)

29867 (JPRS-25104) THE USE OF PENETRATING COSMIC RADIATION FOR DETERMINATION OF MEAN ROCK-DENSITY VALUES. V. M. Bondarenko and A. G. Tarkhov. Translated from Razvedka i Okhrana Nedr, No. 4, 30-4(Apr. 1964). 8p. (OTS-64-31494)

A brief description is given of the apparatus and method used in the determination of rock density values on the basis of cosmic-ray observations in mine workings. Some results are reported for ore deposits in Urals and Central Asia. It is concluded that the method can be combined with an underground gravimetric survey for determination of gravitational corrections. (D.L.C.)

29868 VARIATION OF SOIL TEMPERATURES IN OGOTORUK VALLEY, ALASKA. Robert O. Weedfall (Weather Bureau, Las Vegas, Nev.). Arctic, 16: 181-94(Sept. 1963).

Studies showed that Ogotoruk Valley has unique topographic features that cause marked variations in its climate in comparison with Kotzebue and Cape Lisburne. Normal precipitation totals are lower in Ogotoruk Valley than at Cape Lisburne, but still a little higher than at Kotzebue. The mean maximum temperatures run about 2.5°F below those of Kotzebue and the mean minimum temperatures are about 3°F lower. Because of the nearness of the ocean the extreme minimum temperature at shelter height should not be lower than −52°F and the extreme maximum should not exceed 80°F. A study of the microclimate in the valley up to 7 miles inland showed that marked summer differences exist. Precipitation is heavier along the tops of the hills away from the ocean. Air temperatures, and to a less extent, soil temperatures are depressed more in May and June closer to the cool ocean, whereas in late summer near the relatively warm ocean the minimum temperatures are slightly higher than inland. The temperature extremes occur in the lower parts of the valley, aside from the effects of the ocean. The temperature ranges are less near the rocky hill tops. The peat layer, which covers most of the valley and even parts of the hill tops and is sometimes over a foot thick, is an excellent insulator and has maintained the permafrost at shallow levels. The permafrost persists close to a depth of 50 cm even in August in wet-meadow areas where sedge is the dominant vegetation. Near the creek bed and the tops of the hills, because of more rock in the soil, and in tussock areas, because of slighter compaction between the tussocks, the active layer is thicker. (P.C.H.)

Natural Radioactivity and Fallout

Refer also to abstract 29879.

29869 THE CURRENT FALLOUT PICTURE. John H. Harley (Atomic Energy Commission, New York). Am. Ind. Hyg. Assoc. J., 25: 304-8(May-June 1964).

A general picture of the subject of fallout of ^{90}Sr from weapons testing is presented. The data as of May 1963, on this nuclide in human bone are discussed. Indications of the techniques of predicting this level by calculation from diet levels and from fallout levels are given. (auth)

29870 STUDY OF THE SULFUR ISOTOPE OF SYNTHETIC MELNIKOVITE. Makoto Shima. Sci. Papers Inst. Phys. Chem. Res. (Tokyo), 58: 12-14(Mar. 1964).

The isotope ratio of natural sulfur ($^{32/34}S$) showed the largest isotope fractionation on the geochemical cycle that is called sedimentation. This phenomenon was chiefly described by biological effects. However, at the same time, it occurred in melnikovite precipitation by a chemical reaction. Melnikovite is also decomposed to pyrite and other iron sulfides under natural conditions. Sulfur isotope fractionation was studied during the synthesis and decomposition of melnikovite. It seems to show qualitatively no isotope fractionation. (auth)

29871 ENVIRONMENTAL RADIATION: MEASUREMENTS OF DOSE RATES. Philip F. Gustafson, Jacob Kastner, and John Luetzelschwab (Argonne National Lab., Ill.). Science, 145: 44-7(July 3, 1964).

The exposure dose from environmental sources of radiation was determined by means of an ionization chamber, by gamma-ray spectrometry in the field, and by measurements of radioactivity in soil cores. The exposure dose from cosmic radiation was found to be 4.4 ± 0.2 μr/hr, that from natural radioactivity 8.0 ± 0.3 μr/hr, and the contribution from fission products varied from 2.0 to 7.5 μr/hr during the interval in question. (auth)

29872 BULLETIN OF THE ATMOSPHERIC RADIOACTIVITY, NO. 34, JULY-SEPTEMBER, 1963. Tokyo, The Japan Meteorological Agency, 1964. 70p. (In English and Japanese)

Data are tabulated on the radioactivity in samples of rain water, dusts, and sea water collected at various sites throughout Japan during July, August, and September, 1963. (C.H.)

29873 BULLETIN OF THE ATMOSPHERIC RADIOACTIVITY, NO. 35, OCTOBER-DECEMBER, 1963. Tokyo, The Japan Meteorological Agency, 1964. 66p. (In English and Japanese)

Data are tabulated on the radioactivity in samples of rain water, dusts, and sea water collected at various sites throughout Japan during October, November, and December, 1963. (C.H.)

HEALTH AND SAFETY

Refer also to abstract 29869.

29874 (AD-428592) THE SUSCEPTIBILITY OF EXISTING NAVAL BUILDINGS TO SUSTAINED FIRES RESULTING FROM THE THERMAL PULSE FROM THE EXPLOSION OF NUCLEAR WEAPONS. Phase II Final Report. E. W. Cousins and J. R. Young (Factory Mutual Research Corp., Norwood, Mass.). Jan. 23, 1963. Contract NBy-37596. 18p.

No major change is made in the principal conclusion of the Phase I report, in that under ideal conditions, a conflagration-type fire is remote in buildings surviving a nuclear blast. There is evidence that on more than moderately blast-resistant buildings, asphalt-protected metal, and plastic siding or roofing sheets will continue to flame when exposed to multi-megaton weapons which do not significantly damage the building by blast. Large-scale building details do not conserve enough heat from transient flaming to produce continued burning on smooth wood surfaces, but small-scale details producing narrow parallel spaces and many edges can produce incipient fire by continued small-scale flaming and glowing spots. No definite information could be obtained for smooth-surfaced built-up roofing; but from results of some components, it is concluded that on a more than moderately blast-resistant building exposed to multi-megaton weapons, the chance of continued burning is great enough to warrant resurfacing with gravel or slag. (auth)

29875 (AEEW-M-334) CALIBRATION OF THE A.E.E. WINFRITH WHOLE-BODY MONITOR EQUIPMENT WITH SODIUM-24 SOLUTION IN A POLYTHENE MAN-PHANTOM. C. O. Peabody, R. G. Speight, and F. H. Passant (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Apr. 1964. 18p.

Results are presented for the sensitivity of the existing Winfirth Whole Body Monitor equipment when used for measurement of sodium-24 activity in solution in a polythene man-phantom. The relationship is discussed between these results and those expected for the sodium-24 produced in a human body by accidental neutron irradiation. Estimates are made of the additional contribution of chlorine-38 activity at various times after whole body irradiation. (auth)

29876 (CEA-TP-472) SURVEILLANCE ET CONTROLE DES INSTALLATIONS DE MANIPULATION DU BERYLLIUM ET DE SES COMPOSES AU CENTRE D'ETUDES NUCLEAIRES DE SACLAY. (Inspection and Control of Installations for Handling of Beryllium and Its Compounds at Centre d'Études Nucléaires de Saclay). Werderer (France. Commissariat a l'Enérg. Atomique. Centre d'Études Nucléaires, Saclay). Apr. 14, 1964. 7p.

The diversity of working conditions in the areas devoted to operations with Be and Be compounds is summarized, together with the means used to check contamination of surfaces, liquid effluents, and air. Mean surface contamination is of the order of 0.3 $\mu g/dm^2$, while the Be content in effluents varies from 20 to 600 μg/liter. The mean air contamination is about 0.1 of its maximum permissible value. The grain size of the contaminants observed is indicated, together with desirable improvements. (D.C.W.)

29877 (D2-90469) AN EVALUATION OF THE RADIATION HAZARD DUE TO SOLAR-PARTICLE EVENTS. W. R. Webber (Boeing Co. Aero-Space Div., Seattle). Dec. 1963. 109p.

A concise but comprehensive treatment of the current knowledge of solar-particle events is presented. A qualitative description is given of the various methods of detecting solar-particle events, and all of the pertinent data available are tabulated. The characteristics of each of the events were determined and from these, the intensities and the characteristic rigidities are estimated for each event. Based upon this information, the radiation doses are calculated for each event and cumulative dose-probability curves are derived. Comments are included regarding missions in solar cycle 20 predicted for 1964 to 74 and various techniques for predicting the occurrences of solar-particle events. Solar flare data for 1956 through 62 are given. Supersedes D2-11608. (auth)

29878 (HW-SA-3434) PLUTONIUM AEROSOL PARTICLE SIZE DISTRIBUTIONS IN ROOM AIR. B. V. Anderson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 15, 1964. Contract AT(45-1)-1350. 23p. (CONF-561-1)

From the Symposium on Inhaled Radioactive Particles and Gases, Richland, Wash., May 1964.

The particle size of plutonium aerosols in employee work areas is an important consideration in the analysis of long-term continuous exposure received by radiation workers. The particle-size distributions found in work areas of a plutonium processing area were determined by routine air sampling. Autoradiographic examination of the air samples was utilized to determine the equivalent spherical particle sizes in a range from about 0.05 to 10 microns. Aerosols consisting of essentially nonradioactive inert materials and plutonium oxide or plutonium carbide were examined. The plutonium particle distributions observed are compared to similar data in the literature on controlled oxidation or burning of plutonium with controlled atmospheres and conditions. (auth)

29879 (KY-458) ENVIRONMENTAL MONITORING SUMMARY FOR THE PADUCAH PLANT FOR 1962 AND 1963. R. C. Baker (Paducah Gaseous Diffusion Plant, Ky.). July 1, 1964. Contract W-7405-eng-26. 12p.

Data are presented on radioactivity in samples of air, water, and vegetation collected in the vicinity of the Paducah Gaseous Diffusion Plant, Ky., during 1962 and 1963. (C.H.)

29880 (LADC-6219) A STUDY OF BERYLLIUM SURFACE CONTAMINATION AND RESUSPENSION. R. N. Mitchell and B. C. Eutsler (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract [W-7405-eng-36]. 15p. (CONF-555-1)

From the International Symposium on Surface Contamination, Gatlinburg, Tenn., June 1964.

A 20 × 30 ft wooden building that had been used for storage of beryllium metal and beryllium oxide was used for contamination removal and resuspension studies. Swipe samples were taken by rubbing a 5 × 8 in. piece of Whatman #41 filter paper over an area of one square foot of the wooden floor. Swipe results varied from 10 to 257 μg Be/ft^2. Cleaning the floor by scrubbing with soap and water reduced the swipe values to 2 μg Be/ft^2 or less. Sections of the floor in the cleaned areas were removed and analyzed for beryllium. These floor sections contained 860 and 1860 μg Be/ft^2. The beryllium contamina-

tion on the floor was resuspended by vigorous sweeping. Air concentrations found during two resuspension tests ranged from 4.1 μg Be/M^3 to 25.8 μg Be/M^3. (auth)

29881 (LAMS-3090) RESPIRATOR DRYING CABINET. Earl J. Cox (Los Alamos Scientific Lab., N. Mex.). May 14, 1964. Contract W-7405-eng-36. 8p.

In the routine decontamination of respirators at Los Alamos Scientific Laboratory, space limitations required some type of cabinet drying apparatus. A survey of commercial units revealed no satisfactory solution. A locally fabricated unit, meeting all requirements, is described. (auth)

29882 (SC-R-64-145) BASIC DESIGN REQUIREMENTS FOR LAMINAR AIR FLOW DUST CONTROL DEVICES. W. J. Whitfield, J. C. Mashburn, W. E. Neitzel, and L. C. Trujilo (Sandia Corp., Albuquerque, N. Mex.). May 1964. Contract [AT(29-1)-789]. 19p. (CONF-545-1)

From the AEC Plant Facilities Management Meeting, St. Petersburg, Fla., May 1964.

Laminar air flow principles and basic design requirements for laminar air flow clean rooms, clean benches, and laminar flow hoods are described. Also discussed are: final filter mounting requirements, plenum design, location of clean room lighting, clean room construction materials, air ducts, air distribution, clean room floors, and noise control design considerations. (auth)

29883 (UJV-936/63) AKTIVIROVANNYI SERNOKISLYI BARII V KACHESTVE SORBENTA MIKROSTRONTSIYA. CHAST I. (Activated Barium Sulfate Acting as a Sorbent for Microstrontium. Part I). Lubomír Berak (Ceskoslovenská Akademie Věd. Ústav Jaderného Výzkumu, Řež). June 28, 1963. 36p.

Decontamination of waters containing radiostrontium is complicated by the presence of geochemically similar soluble calcium salts. Experiments were conducted to evaluate the separation of microstrontium from calcium salts by activated $BaSO_4$. Maximum activation was affected by calcium sulfates. Calcium sulfate impurities interfered with the normal formation of $BaSO_4$ crystallites, promoting a submicroscopic particle mass of high internal depression. When placed in a solution, the $CaSO_4$ is rapidly leached leaving a large sorption active surface. Isomorphous cations present in Sr^{2+} solution fill the anomalous vacancies in the $BaSO_4$ lattice forming a mixed crystal. With Sr^{2+} concentrations $<10^{-3}$M the secondary sorption slowed the $BaSO_4$ recrystallization, and strontium retention was achieved by cation exchange between Ca^{2+} and Sr^{2+}. The method is considered efficient for decontamination of drinking water. (R.V.J.)

29884 THERMAL EFFECTS OF SIMULATED NUCLEAR FLASH ON AIRCREW MEMBERS. W. C. Kaufman, H. T. Davis, and A. G. Swan (Wright-Patterson AFB, Ohio). Aerospace Med., 35: 345-50(Apr. 1964).

Attempts were made to assess the effects of simulated nuclear flash on the pilot and cockpit of a tactical aircraft and determine the tolerance of the operationally clothed crewmember to severe radiant energy pulses. The study was also designed to determine accurately what skin temperatures can be expected to result from exposure to the diffuse radiant energy produced by the fireball of a special weapon detonation. A nuclear flash was simulated by 960 tungsten-filament quartz lamps mounted in an aluminum reflector so that they were ~18 in. from the canopy of a salvaged aircraft. A 6000-kw power source was suitably programed to simulate the nuclear thermal radiation pulse. When operationally clothed subjects seated in a cockpit were exposed to graded thermal energy pulses, limits of thermal tolerance ranged from 2.6 to 3.4 cal/cm^2, at forehead level, delivered in a 3-sec pulse. These pulses produced painfully hot sensations at the forehead, and charred cardboard and seared flying gloves, but there were no skin burns. In supplementary lab studies, skin on the back of the hands of subjects exposed to this sort of energy reached 110°F at the limit of tolerance. This temperature resulted from exposure to 3.4 cal/cm^2 delivered in an 11-sec exposure. The temperatures described as painful here are lower than those generally considered necessary to produce true pain and the amount of energy producing them is two to four times greater than that previously reported or predicted. This difference in the relation of temperature response to energy applied is due to spectral differences of the energy which result from the absorption characteristics of the Plexiglas canopy. The data can be used by the physical scientist to calculate nearest safe distance for the crewmember. (BBB)

29885 STENOSIS AFTER EXPLOSION OF LITHIUM HYDRIDE. Arthur J. Cracovaner. Arch. Otolaryngol., 80: 87-92(July 1964).

A case of lithium hydroxide burn due to explosion of lithium hydride is reported. Since this chemical only recently has been found to be useful in industrial and nuclear technology, it is important to record its effect upon the mucous membranes. The burn caused scarring of both corneas, stricture of the larynx, trachea, bronchi, and esophagus, all of which required active treatment that was eventually unsuccessful. (auth)

29886 FALLOUT RADIATION HAZARD TO HOSPITALS. W. R. Waters. Can. Hosp., 40: 45-8(Apr. 1963).

The Canadian Army Operational Research Establishment (CAORE) model of the fallout distribution in Canada consequent on a nuclear attack on North America is discussed. Using the probability data supplied by CAORE, Federal Emergency Health Services classified the Canadian hospitals of 25 beds or over, which lie outside target areas, in respect of the chance that an exposure dose of 600 r would not be exceeded. A survey of these data shows that in many hospitals a high level of shielding is a special requirement if patients and health workers are to be accorded the necessary protection. Means and materials for shielding hospitals are described, and the shielding characteristics of various building materials are tabulated. The design of two hospitals is examined in detail to show existing and required protective factors. Ancillary equipment needed to ensure adequate ventilation, sanitation, and a reserve water supply is mentioned, as are the contact and ingestion hazards of fallout. (BBB)

29887 RADIATION PROTECTION IN CANADA. PART I. P. M. Bird (Dept. of National Health and Welfare, Ottawa). Can. Med. Assoc. J., 90: 1024-30(Apr. 25, 1964).

The current status of radiation protection in Canada is summarized, with particular emphasis on the role of the Radiation Protection Division of the Department of National Health and Welfare. Somatic and hereditary effects of radiation exposure are discussed as a basis for interpretation of the radiation protection standards developed at national and international levels. Development of the Department's program is traced back to 1949. A chart is provided to show the activities of the Radiation Protection Division and its lines of contact with other departments and agencies at both federal and provincial levels. Another chart summarizes the legislative action taken at provincial level to provide control of radiation hazards, which are

concerned with the control of mostly industrial uses of x rays and radioisotopes. (BBB)

29888 RADIATION PROTECTION IN CANADA. PART II. THE ROLE OF THE RADIATION PROTECTION DIVISION IN SAFEGUARDING THE HEALTH OF RADIATION WORKERS. P. M. Bird (Dept. of National Health and Welfare, Ottawa). Can. Med. Assoc. J., 90: 1075-80(May 2, 1964).

The current status of radiation protection in Canada is discussed with particular emphasis on the role of the Radiation Protection Division of the Department of National Health and Welfare. (BBB)

29889 RADIATION PROTECTION IN CANADA. PART III. THE ROLE OF THE RADIATION PROTECTION DIVISION IN SAFEGUARDING THE HEALTH OF THE PUBLIC. P. M. Bird (Dept. of National Health and Welfare, Ottawa). Can. Med. Assoc. J., 90: 1114-20(May 9, 1964).

The program of the Radiation Protection Division in the assessment of radiation exposure of the public from radioactive fallout, effluent from nuclear reactors, natural background radiations, and x rays used for medical purposes is outlined. (BBB)

29890 CONTRIBUTION TO THE PROBLEM OF BACTERIAL CONTAMINATION OF WATER USED IN BORING IN URANIUM MINES. R. Karasek and M. Kubat (Inst. for Industrial Hygiene and Prevention of Occupational Diseases, Jachymov, Czechoslovakia). Cesk. Hyg., 7: 536-42 (Oct. 1962). (In Czech.)

Bacterial counts were made in the drilling and refuse water in U mines, in relation to the lining of the entrance of the mine, under different microclimatic conditions. Various working processes influence the occurrence of microorganisms in the mine water, particularly of Escherichia coli. The radioactivity of the refuse waters in mines does not influence the number of microorganisms present in it. Mine waters used for technological purposes should be classified as drinking water and must be adequately treated before use, if possible at a suitable place of the water circulation system. (BBB)

29891 THE NEED FOR IMPROVING WORKMEN'S COMPENSATION FOR RADIATION INJURIES. Arthur J. Goldberg (Dept. of Labor, Washington, D. C.). Compensation Med., 12: 4-7(Dec. 1961-Feb. 1962).

The statement made by the former Secretary of Labor to the House of Representatives Committee on Education and Labor on January 29, 1962, is reported. It is concluded that the existing workmen's compensation programs in many State jurisdictions do not provide adequate protection against work-connected radiation injuries. Recommendations for overcoming these deficiencies are offered. (BBB)

29892 RADIO-CONTAMINATION OF FOODSTUFFS AFFECTED BY ATOMIC OR HYDROGEN BOMB EXPLOSION. XI. RADIOCHEMICAL ANALYSIS OF RADIO-CONTAMINATED LIVER OF FISH CAUGHT IN THE PACIFIC OCEAN IN 1960. Kakuma Nagasawa, Katsuaki Kametani, Yasumasa Kido, and Sigeru Yamada (National Inst. of Hygienic Sciences, Tokyo). Eisei Shikensho Hokoku, 79: 1-6(Sept. 1961). (In Japanese)

The ashes of liver of fish caught in the Pacific Ocean in 1960 were analyzed for radio-contamination by ion-change and precipitation methods. Techniques are shown for the separation of some radionuclides from solutions of the ash by Amberlite IR-120 column chromatography and a fractional precipitation scheme. Thus ^{90}Sr, ^{65}Zn, and ^{113m}Cd were identified and quantitatively analyzed. The maximum concentrations of ^{90}Sr, ^{65}Zn, and ^{113m}Cd were 5.04×10^{-8}, 1.35×10^{-4}, and 2.78×10^{-6} $\mu C/g$ of wet tissue respectively. If 10 g of fresh tissue is assumed to be the daily Japanese fish dietary intake, the estimated amounts of dietary radionuclides were less than the maximum permissible concentration. In the case of ^{65}Zn and ^{90}Sr the estimated Japanese daily intakes from fish are 1/163 and 1/437 of the limits proposed by the International Commission for Radiological Protection in 1958. These assays of fish ash were made on samples obtained in September and October, 1960. (BBB)

29893 THE MEDICAL CONTROL OF THE NUCLEAR WORKERS (EURATOM SYMPOSIUM, TOURS; OCTOBER 7-9, 1963). E. Strambi (CNEN, Rome). Energia Nucl. (Milan), 11: 263-7(May 1964).

A report is given on the 2nd Euratom Symposium on the medical control of nuclear workers, held in Tours in October 1963. (auth)

29894 A REVIEW OF THE AMENDMENTS TO THE REGULATIONS FOR THE MEDICAL USE OF RADIATION AND CONSTRUCTION AND INSTALLATION IN HOSPITALS. K. Takeshita (Kyushu Univ., Fukuoka, Japan). Fukuoka Igaku Zasshi, 54: 126-34(Feb. 1963). (In Japanese)

The recommendations of the International Commission for Radiological Protection (ICRP) and the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) relating to hazards in clinical applications of ionizing radiations are discussed. (BBB)

29895 EVALUATION OF METHODS FOR DETERMINING AIR CONTAMINATION BY RADON DAUGHTER PRODUCTS. I. I. Gusarov and V. K. Lyapidevskii (Sechenov Inst. of Medical School, Academy of Sciences, USSR and Moscow Inst. of Engineering and Physics). Gigiena i Sanit., No. 1, 56-65(Jan. 1964). (In Russian)

Methods for determining air contamination by radon daughter products were classified and analyzed. Characteristics are given of various methods for determining selected radon products and unknown mixtures of products per unit of analyzed air. Comparisons were made of the accuracy of certain methods. The total calculation method and separate determination offer results of almost identical accuracy (±5%) for total α-decay energy. (R.V.J.)

29896 "CIVIL DEFENSE": THE PRIME NECESSITY OF A MODERN WAR. G. Mennonna (Ministero della Difesa-Esercito, Rome). Giorn. Med. Mil., 112: 3-14 (Jan.-Feb. 1962). (In Italian)

Attention is drawn to the issue of civil defense at the various levels of government and public opinion, and to the danger to survival especially in Europe and North America. The stockpiles of the United States, Russia, England, and France are discussed from published figures and estimates. The various zones of destruction by a 1-megaton bomb are outlined, as well as the loss in human life, calculated for the explosion of a 1-megaton bomb over the center of Paris. A few of the problems of medical care, such as the quantity of blood and plasma needed, are touched upon briefly. The Civil Defense program in the United States is discussed. Expansion of the Red Cross for civil protection into this area is recommended. (BBB)

29897 INVESTIGATIONS OF THE OCCUPATIONAL EXPOSURE TO RADIOACTIVE PAINTS IN POLISH INDUSTRY. D. Brykalski, W. Czosnowska, D. Depczyk, A. Gawroński, J. Liniecki, C. Różycki, and T. Spodenkiewicz. Med. Pracy, 14: 297-312(1963).

Work with luminous paints presents the main hazard of internal irradiation in conventional industry. Introduction of ^{90}Sr as a phosphorescence exciting agent caused mixed internal contamination (Ra + ^{90}Sr) in several people. Altogether 259 persons were investigated, of whom 65 were identified as internally contaminated with radium or ^{90}Sr, or both nuclides. These estimations were based on analysis of excreta and of radon in the breath. In nobody did the estimated body load exceed the maximum permissible level, and no unequivocal clinical evidence of injury was found. Nevertheless, from the discussion of results it follows that in the past the exposure did exceed the maximum permissible levels and that an improvement of the working conditions has since then been achieved. (Excerpta Med., Sect. XXIII, 1: No. 3, (March 1964)).

29898 RADIOLOGICAL HYGIENE PROGRAM OF THE U. S. ARMY. Adam J. Rapalski and Maxwell Dauer (Army Chemical Center, Md.). Military Med., 126: 668-73(Sept. 1961).

The program, briefly reveiwed here, is under the technical supervision and guidance of The Surgeon General of the Department of the Army, and is designed to assure that adequate safeguards are provided to control and minimize potential radiation health hazards to those occupationally exposed, as well as to others in the immediate environment who could inadvertently be exposed. The occupational group in 1960 was ~15,000 persons. Possible sources of military personnel exposure are identified. Radiation standards or guides which are used for occupational exposure in the U. S. Army are listed in a table. (BBB)

29899 THE 1962 CIVIL DEFENSE EMERGENCY HOSPITAL PROGRAM. Arnold H. Dodge (Public Health Service, Washington, D. C.). N. Y. State J. Med., 63: 3144-6(Nov. 1, 1963).

The federally sponsored CDEH (Civil Defense Emergency Hospital) plan is discussed and attempts made to determine whether this plan is properly directed, whether the greatest emergency care capacity yield per dollar spent is being accomplished, and whether there are alternate or concurrent measures which should be initiated better to achieve the objective. (BBB)

29900 TASK, ORGANIZATION, AND LEGAL ASPECTS OF RADIATION PROTECTION WORK. János Bonta. Nepegeszsegugy, 43: 97-101(Apr. 1962). (In Hungarian)

The organization of the various agencies and departments in Hungary which are responsible for radiological protection of those exposed to radiation hazards is described. (BBB)

29901 RADIATION PROTECTION IN HOSPITAL ROENTGENOLOGIC DEPARTMENTS. Gyula Koczkás, Károly Dosay, and Iván Bojtor (Országos Roentgen és Sugárfizikai Intézet, Budapest). Nepegeszsegugy, 43: 101-4(Apr. 1962). (In Hungarian)

The necessity of attaching individual radiation-measuring devices to personnel working in x-ray departments is discussed; such devices are essential to point out any discrepancies in the safety factor of protective apparatus or working conditions. A survey is described in which 9000 exposed films which were processed showed that 91% of hospital radiology personnel receive less than a 0.1-r dose per week; 6.9%, 0.1–0.3 r; and 1.3%, less than 0.3 r. In the instances where greater doses were recorded, carelessness on the part of the personnel was later discovered. The proper protection of patients being treated or examined is also stressed, and the various uses of protective coverings, such as lead and lead-rubber shields, are described. Special attention is paid to gonad protection of men and women, and it is pointed out that very little can be done to protect the ovaries from scattered radiation during abdominal radiologic examinations, and therefore extra care should be taken to use as small a radiation dose as feasible. It is suggested that x-ray technicians should not strive for a classic x-ray photograph which is exposed from border to border; it is better to have the edges less esposed than the object being examined. (BBB)

29902 RADIATION PROTECTION IN INDUSTRIAL ROENTGENOLOGIC STUDIES. Sandor Eder (Orszagos Munkaegészségügyi Intézet, Budapest). Nepegeszsegugy, 43: 104-6(Apr. 1962). (In Hungarian)

Protection problems in industrial x-ray applications are discussed, on the basis of a survey indicating that today perhaps more than 100 plants in Hungary use x rays industrially. The necessity for using individual dosimeters at all times is discussed. (BBB)

29903 EXPERIENCE IN THE PREVENTION AND THERAPY OF RADIATION INJURIES RELATED TO THE APPLICATION OF ISOTOPES. László Kovács, Tíbor Predmerszky, and Endre Voit (Országos Munkaegészségügyi Intézet, Budapest). Nepegeszsegugy, 43: 107-10(Apr. 1962). (In Hungarian)

Preventive measures relating to hazards of open and closed radioactive preparations and isotopes used in labs as well as out of doors are discussed. Special attention is given to isotopes used in gynecology, where in certain cases the special precautions cannot be observed, and, therefore, the personnel should be rotated to avoid overexposure. Safety precautions for radioisotope labs are considered. (BBB)

29904 ROLE OF MEDICAL EXAMINATION IN RADIATION PROTECTION. István Loványi (Országos Munkaegészségügyi Intezet, Budapest). Nepegeszsegugy, 43: 110-13(Apr. 1962). (In Hungarian)

Regular medical examinations of persons occupationally exposed to radiation are deemed a necessary supplement to dosimetry. Medical criteria for employment in such positions are identified. The use of periodic blood tests of employees is discussed in detail, and it is stressed that the blood tests might indicate excessive radiation exposure. (H.M.G.)

29905 REGULATION OF THE AMOUNT OF RADIATION EMPLOYED IN MEDICINE: A CHALLENGE AND AN OPPORTUNITY. Paul C. Hodges (Univ. of Chicago). Postgrad. Med., 35: A77-80(Feb. 1964).

Responsibilities of physicians, especially radiologists, in minimizing patient exposure in diagnostic radiology procedures are discussed. It is suggested that, even in nonmedical applications, regulating agencies have gone too far in stipulating technical details, and that such agencies will do much harm and no good if they attempt to formulate regulations or even guidelines relative to clinical use. It is proposed that physicians themselves must re-examine the steps they are taking toward the most economical clinical use of radiation, educating and disciplining themselves, and continuously informing others what they are doing. Various ways whereby unnecessary x rays can be avoided, such as by using other diagnostic techniques, are also discussed. (BBB)

29906 PLUTONIUM INHALATION STUDIES. V. RADIATION SYNDROME IN BEAGLES AFTER INHALATION OF PLUTONIUM DIOXIDE. J. E. West and W. J. Bair (General Electric Co., Richland, Wash.). Radiation Res., 22: 489-506(July 1964). (HW-SA-3160)

The clinicopathologic changes in beagles after a single inhalation exposure to about 2 mC of $^{239}PuO_2$ aerosol are described. Death occurred in 4 of 5 dogs within 96 days. The earliest clinical change was a progressive depression of lymphocytes beginning within 1 week after exposure. Radiation damage to the lungs was first evidenced by increased respiratory rates at 5 weeks after exposure. Respiratory rates of over 200/min, a tenfold increase above the normal breathing rate, occurred before death. Cyanosis, a concomitant finding at later stages, was an additional indication of injury to the lungs. Other important signs included anorexia, dehydration, and progressive weight loss of up to 25% of pre-exposure values. Tissue changes were limited to the lungs and associated lymph nodes which contained 99% of the body burden of Pu. (auth)

29907 TRIALS FOR THE EXPERIMENTAL DECONTAMINATION OF MEDITERRANEAN SHELLFISH POLLUTED BY WATERS MADE RADIOACTIVE. M. Leandri and J. Charrel. Rev. Hyg. Med. Sociale, 11: 411-16(1963).

An experimental radioactive shellfish does not seem to possess any biological possibility of self-decontamination. Its decontamination is exactly parallel to the curve of decrease of the contaminating isotope. The placing in salubrious water would therefore be of no use in the case of accidental contamination: however, it must be pointed out that it would not result in any contamination of other shellfish. (Excerpta Med., Sect. XXIII, 1: No. 3, (March 1964)).

29908 ASTROPHYSICAL AND RADIOBIOLOGICAL ASPECTS OF HUMAN SPACE FLIGHT. Antonio Pasinetti and Laura E. Pasinetti (Università, Milan). Riv. Med. Aeron., 25: 466-99(July-Sept. 1962). (In Italian)

Various types of radiation in space are tabulated; their origins, distributions, and biological effects are considered. The distribution of soft and hard cosmic radiation in geoatmospheric space is examined. The extraatmospheric space studies consider, in particular, primary cosmic rays and their sources, as well as cosmic ray energies in relation to the density of other types of radiation; solar radiation, especially proton beams; Van Allen radiation, distinguishing between the two belts. Radiobiological and dosimetric effects of travel through various regions of space are examined and calculated. The ratios of radiation external to a vehicle and the internal radiation are calculated for a number of cases; protons, electrons, and cosmic rays are included. In particular there are tabulated proton doses external and internal to a vehicle with various shielding devices in the first Van Allen belt for $\Phi_P = 2 \times 10^4/cm^2$ sec, Bremsstrahlung x photons calculated for the interior of a vehicle in the center of the first Van Allen belt ($\Phi_e = 10^9/cm^2$ sec), and total doses for both types of radiation in the interior of the vehicle. Studies of similar types are explained for the second belt, and the Bremsstrahlung calculations are tabulated. Relative effectiveness of biological shielding methods are discussed, and the radiolesions produced by protons of various energy are tabulated. The lesions produced by soft and very soft x photons are shown graphically. Methods are suggested to reduce the absorbed dose and to prevent radiological lesions. (BBB)

29909 PUBLIC HEALTH PROBLEMS ASSOCIATED WITH RAW PET MEAT; THE USE OF IONIZING RADIATION FOR THE TREATMENT OF RAW MEAT. F. J. Ley (Atomic Energy Research Establishment, Wantage, Berks, Eng.). Sanitarian (London), 71: 185-93(Nov. 1962).

The use of radiation to preserve raw pet meat was stimulated by requests from horse-meat dealers for a process which could effectively deal with contaminating salmonellae and leave the product in the raw state. The following aspects of the process are considered: efficiency of the treatment with respect to salmonellae elimination; effect of the required dose on the quality of the meat; cost of the process and its practicability of operation; and legislation regarding its use. Treatment of frozen horse meat using the Package Irradiation Plant at Wantage Research Laboratory is described and illustrated. Design of the plant required for commercial processing is described in detail and costs are estimated. Therefore, the main difficulty in putting the process into operation would be with regard to the legal position in controlling its use and the sale of irradiated food. (BBB)

29910 RADIOACTIVE CONTAMINATION OF DUTCH FOODSTUFFS. J. W. Haken and H. J. Hardon. Voeding, 24: 535-45(1963).

Figures are given for the ^{89}Sr, ^{90}Sr, ^{131}I, and ^{137}Cs contamination of food in Holland during 1961 and 1962. The values are expressed in pc/kg, for ^{89}Sr and ^{90}Sr also in pc/gCa. In milk, delivered in Amsterdam, the ^{90}Sr content rose to 12 pc/gCa in May 1962 and remained at that level. ^{89}Sr in milk reached maxima of 110 pc/gCa in November 1961 and 83 pc/gCa in September 1962. ^{137}Cs was fairly constant at 80 pc/kg from May 1962 on. In vegetables, a mean ^{90}Sr content of 40 pc/gCa was found, with a maximum of 151 (Swedish turnip). In wholemeal bread, ^{90}Sr values amounted to ±200 pc/gCa; ^{137}Cs is ±120 pc/kg (in ryebread up to 500 pc/kg). The daily intake per head, for winter 1962/'63 was calculated at 20.9 picocuries ^{90}Sr (= 21 S. U.) and 160 picocuries ^{137}Cs. (Excerpta Med., Sect. XXIII, 1: No. 1, (Jan. 1964)).

29911 VOPROSY RADIATSIONNOI MIKROBIOLOGII V SANITARNOI OKHRANE VODOEMOV. (Questions of Radiation Microbiology in the Sanitary Protection of Reservoirs). V. M. Zhogova. Moscow, Izdatel'stvo Meditsina, 1964. 158p.

The problem of the protection of reservoirs from contamination with radioactive materials is treated. A summary is given of experimental results and data from the literature which may be useful to judge the effect of radioactive isotopes on the processes of self-purification from organic pollution and on the efficiency of cleaning the installations. A survey is made of general radiobiological effects of alpha and beta emitters, present in an aqueous medium, on the survival, multiplication rate, and biological properties of bacteria. Data on the influence of radioactive contamination on saprophytic and pathogenic microflora in water and on the processes of mineralization and nitrification of organic material are presented. Attempts are made to explain the accumulation of radioactive material by bacteria cells. (tr-auth)

29912 SHIPPING IRRADIATED FUELS FROM NUCLEAR REACTORS. Steven H. Brown. 12p. (CONF-524-3)

From American Institute of Mining, Metallurgical and Petroleum Engineers Annual Meeting, New York, Feb. 1964.

Shipment of irradiated fuels from nuclear reactors and processing plants is discussed in regard to: regulations and controls; present practice; technological developments; economics of fuels; and shipping operations. (H.M.G.)

INSTRUMENTATION

General

Refer also to abstracts 30082, 30166, 30265, and 30709.

29913 (AD-430654) TRANSIENT GAMMA RADIATION EFFECTS ON ELECTRONIC SYSTEMS. (Hughes Aircraft Co., Fullerton, Calif.). Aug. 29, 1963. 157p. (FR-63-17-179)

A series of summaries of the current state-of-the-art on transient gamma radiation effects on electronic components is presented. Charge injection and charge leakage are considered: ionization and increases in conductivity of gases; changes in conductivity, increases in minority carrier concentration, and production of electron-hole pairs in semiconductors; decreases in insulation resistance and breakdown strength in insulators; electron emission from materials by photo- and Compton effects; and fluorescence. The report was compiled for the PHOENIX Project. (R.E.U.)

29914 (AERE-M-1416) ASSOCIATIVE STORAGE BY ADAPTATION OF A STANDARD PULSE ANALYSER. E. H. Cooke-Yarborough and I. N. Hooton (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). June 1964. 10p.

A 4096-channel pulse analyzer with 20-bit capacity per channel is considered in the adaptation to content-addressable stores whereby 2048 different descriptors (digital 20-bit words) can be stored in alternate channels. (R.E.U.)

29915 (AFCRL-63-939(3)) EQUIPMENT FOR MEASUREMENT OF MAGNETIC FIELD VARIATIONS FOR DASA PROJECT 6.5A. Final Engineering Report III, February 28–November 30, 1962. F. J. Morris, C. R. Coale, W. E. A. Ruska (Electro-Mechanics Co., Austin, Tex.); and E. J. Chernosky (Air Force Cambridge Research Labs. Geophysics Research Directorate, Bedford, Mass.). Apr. 30, 1963. Contract AF19(604)-5520. 18p. (AD-428271)

Magnetometers were constructed for the purpose of instrumenting two field magnetic and telluric observatories. The purpose of these observatories, established and operated in the Pacific area, was to measure and record geomagnetic phenomena corresponding to the high-altitude nuclear test series in 1962. The stations were manned and data were successfully taken for all events specified to be of interest by the contract monitor. (auth)

29916 (CERN-64-27) RF BROAD-BAND AMPLIFIERS FOR DRIVING REACTIVE LOADS. A. Fiebig (European Organization for Nuclear Research, Geneva). June 4, 1964. 53p.

Some methods for coupling capacitive loads to amplifiers are discussed. For comparing their "efficiencies," a quantity called reference power is defined. This is given as the product of either the maximum or the average current and the maximum voltage in the desired frequency band. This number determines the necessary voltage and current, and also, to some extent, the power rating of the driving valve and the necessary d-c power. A distinction is made between low-Q and high-Q bandfilter coupling techniques. From the maximum ratings point of view, the high-Q technique is preferable. It is found that for a high-Q double-tuned filter, one needs $1/\sqrt{2}$ of the reference power needed for a low-Q single circuit, and for a three-circuit high-Q filter, one needs about 0.77 of the reference power needed for a double-tuned filter. Another coupling technique is discussed, using the characteristics of a classical bandpass filter chain. This yields equal or more favorable results than a three-circuit bandfilter, but needs more coupling network elements. (auth)

29917 (CONF-546-1) A RECORDING LINEAR-RESPONSE GAGE FOR VACUUM FUSION ANALYSES. Harold F. Waldron (Mallinckrodt Chemical Works. Uranium Div., St. Charles, Mo.). [nd]. Contract W-13-108-eng-8. 14p.

From the Conference on Analytical Chemistry and Applied Spectroscopy, Pittsburgh, Mar. 1964.

A strain gage manufactured by Statham Instruments, Inc., provides a reliable transducer for the continuous recording of the pressure in an analytical vacuum system. The transducer with the power supply and control circuitry that is described provides an instrument of multi-range and linear-response characteristics that has been highly reliable over a three-year period of operation. Zero suppression permits the shift of all ranges with respect to the fore-line reference pressure. The gage may be used to indicate pressure trends in the system or it may be calibrated to provide absolute pressure measurements. The direct indication of gas evolution, reaction, or separation rate has been an invaluable aid in procedural development and has eliminated a dependence on a predetermined time schedule for actual analyses. Application data, for the determination of oxygen in uranium using a typical full-scale range of 750 millitorr, is presented. (auth)

29918 (CONF-567-1) A REVIEW OF PUBLISHED RELIABILITY DATA ON MICROELECTRONIC INTEGRATED CIRCUITS. J. H. Ward (Knolls Atomic Power Lab., Schenectady, N. Y.). Apr. 22, 1964. Contract [W-31-109-eng-52]. 26p.

From the Semiconductor Applications and Manufacturer Symposium, Syracuse, N. Y., May 1964.

A review is presented of published data on microelectronic integrated circuits manufactured by Motorola Semiconductor Products, Texas Instruments, and Fairchild Semiconductor. Methods of testing are discussed, and results are given for moisture resistance, steady-state operation life, high-temperature life (nonoperating), corrosion in salt atmosphere, temperature cycling and thermal shock, centrifugal acceleration, mechanical shock, strength of terminals, and vibration fatigue. (R.E.U.)

29919 (EUR-528.e) TUNNEL DIODES AS MULTIVIBRATOR FOR FAST COUNTING IN TIME-OF-FLIGHT CODING AND DERANDOMIZING APPLICATIONS. H. Meyer and H. Verelst (European Atomic Energy Community. Central Nuclear Measurements Bureau, Geel, Belgium). 1964. 16p.

In time-of-flight coding devices under development, scalers with high double-pulse resolution, small propagation delay, and especially small delay jitter are necessary. The application of tunnel-diode multivibrators to build up such fast scaler is considered. A simplified circuit theory is proposed and applied to practical circuit design. A ten-stage scaler was built with a maximum rate greater than 300 Mc/s. With tunnel diode univibrators as coupling elements between stages the propagation delay is about 16

mμs with less than 5% jitter. The use of such stages as "pulse derandomizers" is considered. The best measured double-pulse resolution was 2 mμs, but with the pulses momentarily available from fast nuclear counters, limits are mostly given by trigger pulse shape. (auth)

29920 (IBM-63-521-21) EXPERIMENTAL PROGRAM TO DETERMINE THE FEASIBILITY OF USING ANALYTICAL TECHNIQUES IN ANALYZING RADIATION EFFECTS TO FLIGHT CONTROL SYSTEMS. Final Report. (International Business Machines Corp. FSD Space Guidance Center, Owego, N. Y.). Sept. 30, 1963. Contract AF33 (657)-8104. 214p. (RTD-TDR-63-4147; AD-430820)

The effects of pulsed and steady-state nuclear radiation were determined for an advanced flight control system. Experimental studies of selected circuits are described. The objectives were to experimentally measure circuit and component changes, to modify these circuits to improve their radiation tolerance, and to compare the experimental results with theoretical analyses. Five circuits were studied in two series of radiation tests at the Sandia Pulsed Reactor facility. Experimental data were shown to be consistent with theoretical interpretation based on analysis of circuit operation and effects in the individual components. (auth)

29921 (JINR-P-1633) TUNNEL'NYI DIOD, PRIMENIE V SKHEMAKH TSIFROVOI TEKHNIKI I YADERNOI ELEKTRONIKI. (Tunnel Diode, Digital and Nuclear Electronic Circuit Applications). I. F. Kolpakov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1964. 148p.

The third, concluding part of the survey "Tunnel Diode" (the 1st and 2nd parts of the survey were published as a JINR preprint "Tunnel Diode, the Principle of its Operation and the Bases of Circuit Design," P-1362, Dubna, 1963) is presented. In the third part of the survey concerned with home and foreign periodical literature, digital circuits (logic circuitry, memory devices, trigger and counter circuits, analog-to-digital converters) and some nuclear electronic circuits (discriminators, scintillation counters, pulse shapers, coincidence circuits) and some auxiliary measuring devices are considered. The survey is illustrated by 29 diagrams and is supplied with the bibliography of 194 items (143 English items). (auth)

29922 (KFK-201) STEUERGERAT ZUR DATENAUSGABE AUF LOCHSTREIFEN DURCH EIN-ODER ZWEIDIMENSIONALE ABFRAGE DER DATENQUELLEN. (Punch Control Unit With Two-Dimensional Scanning System). R. Hartenstein and U. Jochimsen (Kernforschungszentrum. Institut fur Experimentelle Kernphysik, Karlsruhe, Germany). Jan. 1964. 33p.

A control unit is described that is capable of scanning information of a great number of decades out of scalers and other data sources. Data are punched out at a speed of 50 characters per second. The unit performs parallel-to-serial conversion by means of a two-dimensional scanning system. A modified version of the unit permits data to be punched and typed out simultaneously. (auth)

29923 (LADC-6415) DETECTION OF DENSITY VARIATIONS IN FLOWING TWO-PHASE HYDROGEN. W. L. Willis and J. R. Smith (Los Alamos Scientific Lab., N. Mex.). [1963]. Contract [W-7405-eng-36]. 27p. (CONF-554-1)

For presentation at the Cryogenic Engineering Conference, Philadelphia, Aug. 1964.

Liquid hydrogen is heated by a nuclear reactor and expelled as a hot gas to provide thrust in the Kiwi nuclear engine. The possibility of liquid hydrogen reaching the reactor core during startup was of interest to design engineers. Since thermodynamic equilibrium is not probable during this period, pressure and temperature measurements are not adequate and direct measurement of density is necessary. Requirements included rapid response, remote operation, and noninterference with flow patterns in the reactor. The solution chosen was a measurement in which the propellant density variations changed the value of capacitive probe. The capacitance was part of the tank circuit of a 4.5 megacycle oscillator and generated frequency deviations of about 24 kilocycles per second. This frequency-modulated signal was detected by conventional circuitry to provide a d-c to two kilocycle signal for recording purposes. Gages were used in three cold flow reactors and a mixing chamber intended to blend liquid and gaseous hydrogen to obtain a stream of cold gas. Entrained liquid was detected in gas streams with mean temperatures as high as 294° Kelvin. (auth)

29924 (LRP-14-64) IMPULSIONS HF DE 10 MEGAWATTS SUR IMPEDANCE REELLE, AVEC MODULATION DE FREQUENCE ET D'AMPLITUDE. (HF Discharges of 10 Megawatts Over True Impedance, with Frequency and Amplitude Modulation). R. Keller (Laboratorie de Recherches sur la Physique des Plasmas, Lausanne, Switzerland). June 1964. 16p.

High-frequency wave packets are produced by discharging, successively, transmission lines that are connected in series by spark gaps. 10 Mw of effective power at frequencies up to 10 MHz is obtained. The amplitude and the frequency can be programmed. (auth)

29925 (MDL-Q3) MICROWAVE DEVICES LABORATORY. Consolidated Quarterly Report for the Period October 1, 1962–December 31, 1962. (Utah. Univ., Salt Lake City. Microwave Devices Lab.). Contracts Nonr-1288(05), AF04(647)-745, and AF33(657)-8677. 53p. (AD-402095)

Electron beam devices, solid state devices, and plasmas were studied to extend the useful frequency spectrum from the microwave to optical frequency range, and to improve devices and techniques in the microwave spectrum. A 30-40 kmc multiple ladder-circuit backward-wave oscillator, dielectric slow wave circuits, the orbitron amplifier, a cyclotron-synchronous wave amplifier, multiple beam interactions, and magnetoelectric beam compression were studied under electron beam devices. The solid-state studies covered irradiated laser materials, tunneling, and millimeter wave masers. The plasma studies involved plasma waves, plasma generation and measurements, microwave plasma measurements, rocket exhausts, and thermionic emission from condensed species in rocket exhausts. (auth)

29926 (NAVWEPS-8177) TRANSIENT RADIATION EFFECTS ON ELECTRONICS. Interim Report. J. L. Hill (Naval Ordnance Lab., Corona, Calif.). Jan. 1, 1964. 14p. (AD-429358)

Certain missile electronic circuits using Shockley diodes, silicon-controlled switches, and silicon-controlled rectifiers were irradiated to determine the threshold dose rates for transient effects and to evaluate hardening techniques. This effort has resulted in the design of firing circuits that cannot be initiated by available test levels of gamma radiation. (auth)

29927 (NBL-210(p.35-7)) A FLIP-FLOP SOURCE FILAMENT LOADING ASSEMBLY. S. J. Lorik (New Brunswick Lab., AEC, N. J.)

A device to facilitate the loading of plutonium on the filaments of a multiple source head held inside a glove box was designed and fabricated. (auth)

29928 (NP-13979) DEVELOPMENT OF HIGH-TEMPERATURE CERAMIC RECTIFIERS, THYRATRONS, AND VOLTAGE REGULATOR TUBES. Quarterly Report No. 3, December 26, 1963–March 25, 1964. E. A. Baum (General Electric Co. Tube Dept., Schenectady, N. Y.). Apr. 29, 1964. Contract NAS3-2548. 25p.

Evaluations of the life expectancy of ceramic-to-metal seals were carried out. The active-alloy (NiTi) seals and the metalized, copper-gold brazed, ceramic seals accumulated 2150 hours at 850°C. One of the nickel–titanium seals was found to leak after this time. The Nioro (NiAu) and Palco (Palladium–Cobalt) test seals have accumulated 1250 hours. One of the Palco samples leaked after 930 hours. A cylindrical voltage-regulator tube with a concentric-anode structure has been operated up to 800°C in vacuum and test data have been obtained over the 30 to 80 torr pressure range including voltage variations due to step changes in current. The VR tube was sealed-off and operated at 800°C for approximately 500 hours. Tests have been made of the electron emission from barium on porous graphite. Maximum emission currents in the range of 10 to 100 microamperes were measured with the emitting surface at 940°C. During these tests it was found that the cathode, i.e., the barium source, poisoned during the back-emission tests. Also an evaluation was made of the emission from pyrolytic graphite on molybdenum. The results indicate that the applied coating did not give the properties of pyrolytic graphite. The emission from the molybdenum surface was found to increase continually with temperature. (auth)

29929 (NP-13993) MEASUREMENT OF MOISTURE CONTENT OF SOIL BY RADIOISOTOPES. INFLUENCE, IN THE CASE OF CYLINDRICAL GEOMETRY, OF THE AXIAL SET-UP OF THE DIFFERENT ELEMENTS OF A DEPTH NEUTRON PROBE ON THE USEFUL MOISTURE RANGE AND ON THE SENSITIVITY OF THE PROBE. E. de Beer (Louvain, Belgium. Universite; Ghent. Rijksuniversiteit); and E. H. G. Goelen (Belgium. State Geotechnical Inst., Ghent). [1962]. 24p.

The problem of the continuous determination of the variation of the volumetric water content with depth by means of a neutron probe is examined. Tests were conducted with probes of various cylindrical symmetries in order to study the effects of inner setup of the probe on the results. In the tests, the probe is lowered to the test point in duraluminum tubes. Results are also presented of some field tests. (D.L.C.)

29930 (AEC-tr-6392(p.68-76)) SHAPING OF CURRENT PULSES OF REGULABLE DURATION. V. L. Auslender, O. G. Il'in, and A. M. Shenderovich. Translated from p.94-104 of Materialy Nauchno-Tekhnicheskoi Konferentsii po Yadernoi Fizike i Lineinym Uskoritelyam. Chast' III. Nakopitel'nye Ustroistva.

A method is described of producing current pulses by means of a shaping line and two dischargers. By changing the relative operation time of dischargers one may regulate within wide limits the duration of the pulse. (auth)

29931 (AEC-tr-6392(p.77-80)) SHAPING OF CURRENT PULSES AT VARIABLE LOAD. V. L. Auslender, O. G. Il'in, and A. M. Shenderovich. Translated from p.105-9 of Materialy Nauchno-Tekhnicheskoi Konferentsii po Yadernoi Fizike i Lineinym Uskoritelyam. Chast' III. Nakopitel'nye Ustroistva.

A circuit is described that can be used for pulse shaping at any load. The circuit was originally introduced in report No. AEC-tr-6392(p.68-72). (R.E.U.)

29932 ATTAINABLE ACCURACY OF LOGARITHMIC RC-INTEGRATING-CIRCUITS FOR COUNTING-RATE METERS. H. Weiss (Atominstitut der Osterreichischen Hochschulen, Vienna). Atomkernenergie, 9: 191-6(May-June 1964). (In German)

The function of pulse integrating circuits using an RC element is described. The accuracy of the relationship between output voltage or current and the logarithm of the pulse rate at the input using one RC circuit and several RC circuits superposed is discussed. Diagrams permitted the accuracy and the range attainable within a certain percentage of errors of this relationship between input and output of the integrating circuits to be determined as a function of the number of RC circuits used and the factor separating the circuit time constants of following circuits. A method of attaining more accurate logarithmic characteristics by the superposition of two sets of RC circuits instead of with only one set of RC circuits is described. (auth)

29933 COINCIDENCE-ANTICOINCIDENCE AND LINEAR GATE CIRCUITS. W. Klein (Firma Frieseke-Hoepfner GmbH, Erlangen, Ger.). Atompraxis, 5: 14p. (Oct.-Nov. 1959). (In German)

Coincidence-anticoincidence installations are required for registering an event only if one or more other events occur simultaneously or nonsimultaneously. The optimum coincidence-resolving capacity of an arrangement is dependent upon the input-pulse form and the amplitude range. Adjustment is best made via pulse formers. The function of the actual coincidence-anticoincidence stages is usually based on one of three general circuit patterns: 1. multiplicative mixture (Bothe circuit), 2. additive mixture, possibly with bent characteristic lines (Rossi circuit), and 3. bridge circuits. If an amplitude criterion is required in addition to the coincidence criterion, there are two general types of circuit: 1. amplitude selection before coincidence selection with a) amplitude discriminator with subsequent connection of a coincidence stage or b) fast-slow coincidence spectrometer, and 2. coincidence selection before amplitude selection a) linear gate stage with longitudinal branch control, b) linear gate stage with cross-section branch control, or c) bridge gates. Examples of these circuits are discussed. (auth)

29934 THE INFLUENCE OF HIGH-ENERGY PARTICLE RADIATION IN SPACE ON DIFFERENT KINDS OF TRANSISTORS. W. C. Honaker and F. R. Bryant (Langley Research Center, Hampton, Va.). Atompraxis, 10: 242-5 (May 1964).

Experimental results are presented showing the damage sustained by injection-type and field-effect transistors when irradiated with high-energy protons and electrons. The data are presented in both graphic and tabular form and show that the degradation in transistor parameters varies with transistor frequency, type of junction, and energy of the bombarding particle. The transient effect caused by ionization of gas encapsulated in the transistor can is briefly discussed. (auth)

29935 A DIFFERENTIAL NUCLEAR MAGNETIC RESONANCE MAGNETOMETER. D. E. P. Silver (Mid-Essex Technical Coll. and School of Art, Chelmsford, Eng.). Electron. Eng., 36: 374-7(June 1964).

An instrument was designed which enables measurements of magnetic field distribution over large pole surface areas to be rapidly and accurately taken. Al-

though nuclear magnetic resonance is used in the sensing element, no frequency measurements are required. The apparatus can also be used with good results for an electromagnet supplied from an unstabilized power source. A differential principle is used in which the field intensities at various points in the pole gap are measured with respect to some arbitrarily fixed point in the gap. (auth)

29936 THE GENERATION OF RANDOM-TIME PULSES AT AN ACCURATELY KNOWN MEAN RATE AND HAVING A NEARLY PERFECT POISSON DISTRIBUTION. G. White (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Sci. Instr., 41: 361-4 (June 1964). (AERE-R-4529)

It is shown that the individual microplasma breakdowns in silicon p-n junctions may be used in the generation of pulses with a random time distribution. A practical instrument has been constructed in which the mean output pulse rates are accurately defined at rates between 100 and 10,000 pulses per sec. Much lower rates may be obtained if required. (auth)

29937 LEVEL CONTROL BY GAMMA RELAY. B. Mengelkamp (Allgemeine Elektricitäts-Gesellschaft, Heiligenhaus, Ger.). Kerntechnik, 6: 257-60(June 1964). (In German)

A device for level control using radiation is described. All specifications and data necessary in designing this type of level control are given. (auth)

29938 USES OF NANOSECOND TECHNIQUES. E. G. Stromer. Neue Tech., 6: 148-51(May 1964). (In German)

Applications of fast-pulse technique are described. Step-recovery diodes, switching time, circuit diagrams, applications, and manner of operation are discussed. (auth)

29939 ON SOME SIMILARITY RULES FOR EXTRACTION SYSTEMS OF A HIGH-FREQUENCY ION SOURCE. K. Prelec (Inst. "Ruder Boskovic," Zagreb). Nucl. Instr. Methods, 26: 320-7(Mar. 1964).

Experiments with a high-frequency ion source were performed to verify some similarity rules for extraction systems. The results obtained show that the similarity rules examined are not strictly valid and that a larger extraction system displays less favorable properties than expected. Possible reasons for this behavior are discussed. (auth)

29940 A TUNNEL DECADE DIODE FOR SEQUENCE FREQUENCIES UP TO 250 Mc. J. Weber (Deutsches Elektronen-Synchrotron, Hamburg). Nucl. Instr. Methods, 26: 325-8(Mar. 1964). (In German)

A decade scaler of biquinary type is described, which can be used up to 250 Mc clock-frequency. It consists of a flip-flop and a five stage ringcounter. The coupling problem was solved by coaxial cable inverters which produce only short time delay between the single stage and therefore tunnel diode switching speed can be fully utilized. (auth)

29941 ESR SPECTROMETER WITH HIGH FREQUENCY FIELD MODULATION. I. Pascaru (Inst. of Atomic Physics, Bucharest). Nucl. Instr. Methods, 26: 333-6(Mar. 1964).

An X band ESR spectrometer with high frequency magnetic field modulation, having a sensitivity of $3-4 \times 10^{11}$ spins/Oe, and a resolution of 2×10^{-5} is described. A high stability of the microwave oscillator frequency is obtained by comparison with a quartz-crystal-controlled oscillator. (auth)

29942 THE STABILIZATION OF PULSE AMPLITUDES IN AMPLIFIERS WITH NEGATIVE FEEDBACK. K. Fraenz and H. Paucksch (Telefunken Research Inst., Ulm, Ger.). Nucl. Instr. Methods, 27: 125-8(Apr. 1964).

Formulas and numerical data are given for describing stabilization by negative feedback in the time domain. (auth)

29943 A FAST GENERAL-PURPOSE BINARY-TO-DECIMAL CONVERTER. J. B. Rowles, R. A. W. Steels, and C. H. Vincent (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nucl. Instr. Methods, 27: 129-38(Apr. 1964).

A converter consisting essentially of a register capable of storing a number of decimal digits in binary-coded decimal form is described. Outputs may be required in either binary-coded decimal or decimal form, and the decoders which are needed for this reason are used to assist in the main conversion process. The input of binary digits may be applied in either parallel or serial form, manually or automatically, but in all cases they enter the register serially and are doubled repeatedly within the register as the conversion is effected. The time required for each binary digit is less than 1 μsec. (auth)

29944 IMPROVEMENTS IN MAGNETIC FIELD CONTROL BY PROTON RESONANCE. C. H. Vincent, D. Kaine, and R. S. Titchmarsh (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nucl. Instr. Methods, 27: 156-8(Apr. 1964).

A brief account is given of various advances in the technique by which the field of an electromagnet can conveniently be controlled over the range of 500 to 16000 gauss with an accuracy of about ±0.001% ± 0.1 gauss. The field demanded is set as a proton resonance frequency in kcps on five decade knobs and is, in effect, continuously variable. (auth)

29945 AN AUTOMATIC FOLLOWING MICROSCOPE FOR NUCLEAR EMULSIONS. J. Cox, M. J. Duff, and L. J. Townsend (University Coll., London). Nucl. Instr. Methods, 27: 159-66(Apr. 1964).

An automatic following microscope was developed which will eventually form the basis of a completely automatic measuring system for nuclear emulsions. At the present state of development, grey or black tracks can be followed at speeds up to 2.5 mm/minute, and it seems apparent that further improvements in design will produce higher speeds and allow minimum ionization tracks to be followed. (auth)

29946 THE DESIGN OF A SIMPLE ELECTROSTATIC ANALYSER. I. S. Grant (Univ. of Manchester, Eng.). Nucl. Instr. Methods, 27: 167-8(Apr. 1964).

An electrostatic analyzer designed for measurement of energy losses by charged particles in passage through thin foils is described. Beam energy measurements can be made with an accuracy of better than 0.1% in a few seconds. (D.C.W.)

29947 A HIGH SPEED TRANSISTOR AMPLIFIER. M. A. Schapper (Univ. of Melbourne, Australia). Nucl. Instr. Methods, 27: 172(Apr. 1964).

A simple amplifier with a signal gain of 12.2 and a positive output voltage into a 125-Ω load of up to 7 v is described. The rise time is 2 nsec without any detectable overshoot. The fall time is 3 nsec at low level and 4 nsec at 5-v output. (D.C.W.)

29948 UNIVERSAL DEVICE FOR NEUTRON DIFFRACTION STRUCTURAL ANALYSIS. I. D. Abesadz, G. I. Doidzhashbili, D. F. Litvin, B. G. Lyashchenko, N. N. Protopopov, and V. S. Chikobava (Inst. of Metal Research and Inst. of Physics, Georgian SSR). Pribory i Tekhn. Eksperim., No. 2, 43-6(Mar.-Apr. 1964). (In Russian)

A universal precision neutron-diffraction device with semi-automatic control for investigating crystal and magnetic structure is described. The device can be used in

standard magnetic fields and temperature ranges and also at high pressures. (tr-auth)

29949 PORTABLE PULSE GENERATOR WITH A VOLTAGE OF 300 kv AND A FREQUENCY OF 10c. V. S. Barantsev, I. I. Kalyatskii, and P. E. Klein (Tomsk Polytechnic Inst., USSR). Pribory i Tekhn. Eksperim., No. 2, 108-9(Mar.-Apr. 1964). (In Russian)

A pulse generator for producing a voltage of 300 kv at a frequency of 10c is described. The generator uses a charged condenser across a choke coil and a fractionating inductance. The voltage pulse has an energy of 800 joules and a duration of 10^{-7} sec. (tr-auth)

29950 OMEGATRON MASS SPECTROMETER FOR ANALYSIS OF THE COMPOSITION OF RESIDUAL GASES IN HIGH-VACUUM SYSTEMS. A. P. Averina, G. N. Levina, V. T. Lepekhina, and A. E. Rafalson (Inst. of Analytical Instruments, Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 2, 121-5(Mar.-Apr. 1964). (In Russian)

An omegatron mass spectrometer for investigating the composition of residual gases in vacuum systems and for investigating phenomena occurring in the evacuation, outgassing, and gettering stages in vacuum systems is described. The resolution of the mass spectrometer is given. The mass spectra can be registered on an oscilloscope or by means of a potentiometer. The sensitivity of the method for registration on the potentiometer is $\sim 5 \times 10^{-11}$ torr and 5×10^{-10} torr for the oscilloscope. (tr-auth)

29951 METHOD FOR MEASURING THE DISSOCIATION CROSS SECTION FOR FAST HYDROGEN IONS PASSING THROUGH GAS TARGETS. B. N. Makov, L. I. Elizarov, and E. A. Dmitriev. Pribory i Tekhn. Eksperim., No. 2, 126-7(Mar.-Apr. 1964). (In Russian)

A device for measuring the dissociation cross sections for fast H_2^+ ions passing through gas targets is described. The device contains the gas, a magnetic field, and instruments for comparing the proton and hydrogen ion currents. (C.E.S.)

29952 DEVICE FOR AUTOMATIC SHIFTING OF A MASS SPECTROMETER RANGE. V. I. Zubkov. Pribory i Tekhn. Eksperim., No. 2, 127-8(Mar.-Apr. 1964). (In Russian)

A device is proposed for registering mass spectra over the entire range of a mass spectrometer. The device automatically changes the range of the spectrometer. (tr-auth)

29953 PRESSURE CHAMBER FOR FABRY-PEROT INTERFEROMETER. M. S. Kashtan and T. N. Klopina (All-Union Inst. of Geophysical Exploration, USSR). Pribory i Tekhn. Eksperim., No. 2, 148-9(Mar.-Apr. 1964). (In Russian)

A pressure chamber for adjusting an interferometer without disturbing its pressure seal is described. (tr-auth)

29954 SIMPLE METHOD FOR IMPROVING THE HIGH VACUUM IN MASS SPECTROMETER MI-1305. Yu. E. Selyaninov and K. V. Khomich (Belorussian State Univ., USSR). Pribory i Tekhn. Eksperim., No. 2, 174-5(Mar.-Apr. 1964). (In Russian)

A liquid nitrogen system for improving the vacuum in a mass spectrometer is described. The vacuum was increased from (2–3) to (6–8) $\times 10^{-6}$ torr. (C.E.S.)

29955 LOW-TEMPERATURE RESONATOR FOR EPR STUDIES AT 0.8 cm WAVELENGTH. A. L. Bildyukevich (Kazan State Univ.). Pribory i Tekhn. Eksperim., No. 2, 185-7(Mar.-Apr. 1964). (In Russian)

A low-temperature resonator with H_{01} type waves is described. The object to be investigated can be oriented in both horizontal and vertical planes without rotation of the magnet. To increase the precision of the measurements the instrument contains a tuning plunger resonator in direct proximity with the investigated object. (tr-auth)

29956 APPARATUS FOR NUCLEAR ELECTRON DOUBLE RESONANCE AT 12500 GAUSS. R. E. Richards and J. W. White (Oxford Univ.). Proc. Roy. Soc. (London), Ser. A, 279: 474-80(June 16, 1964).

An apparatus is described for measuring nuclear electron double resonances at magnetic fields of 12,500 gauss, in the microwave radiation of about 35,000 Mc/s, and at nuclear resonance frequencies from 3 to 60 Mc/s. The microwave circuit permits saturation of solutions of certain organic free radicals in non-polar solvents when placed in a microwave cavity with a radio-frequency coil mounted inside. The resolving power of the nuclear resonance spectrometer is better than 1 in 10^8. Recordings are presented to illustrate the performance of the apparatus. (auth)

29957 TIME RESOLUTION OF STREAK CAMERAS EQUIPPED WITH ROTATING MIRRORS OF BERYLLIUM. J. K. Landré (Beckman and Whitley, Inc., San Carlos, Calif.). Rev. Sci. Instr., 35: 796-801(July 1964).

After a brief discussion of the limiting factors in streak record information, a test method is described with which the influence of mirror distortion and air turbulence on the time resolution can be studied. Results for 1 × 2 in. beryllium and steel rotating mirrors are given. The time resolution of a streak camera equipped with a beryllium mirror is found to be a few nanoseconds when the instrument is used as a chronometer; velocity measurements can be carried out with over-all acuracies of a few tenths of a percent. (auth)

29958 HIGH FREQUENCY PROPERTIES OF PEAKING STRIP PROBES. H. J. Huber and K. C. Rogers (Stevens Inst. of Tech., Hoboken, N. J.). Rev. Sci. Instr., 35: 801-2 (July 1964). (SIT-113)

Measurements of the properties of peaking strip probes in rapidly oscillating magnetic fields are presented. Studies were carried out from 18 kc to 2.6 Mc with field rates of change from 8×10^6 to 3×10^{10} G/sec. A typical probe response at $\dot{B} = 10^{10}$ G/sec is a triangular pulse of 1 v amplitude and half-amplitude pulse width of 40×10^{-9} sec at field reversal. (auth)

29959 KERR CELL MEASURING SYSTEM FOR HIGH VOLTAGE PULSES. D. C. Wunsch (Sandia Lab., Albuquerque, N. Mex.) and Ahmed Erteza. Rev. Sci. Instr., 35: 816-20(July 1964).

A system for measuring high voltage pulses with very high resolution is described. The system is based on a unique application of the electro-optic Kerr effect and measures voltage pulses with magnitudes from 3×10^4 to 1×10^5 v. This technique also could be used to measure higher voltages by changing the separation of the Kerr cell plates. The system has a linear frequency response to approximately 100 MHz. Unlike the resolution of other voltage-measuring systems, the resolution of this system increases as the voltage pulse increases towards its peak value. The peak pulse magnitude can be measured with a resolution of better than 0.1%. The system can be calibrated so that the measured value of the peak voltage should be accurate to within ±1% of the true value. This

high resolution is obtained by modulation of a constant intensity light source by action of a Kerr cell. The electric field intensity resulting from the high voltage pulse causes phase differences as great as 25π radians between light components in the Kerr cell. Consequently, many light cycles are obtained during the voltage rise of the pulse. This produces extreme resolution near the peak of the pulse. Near the peak, a 2% change in voltage results in a 100% change in light intensity. (auth)

29960 EPR SPECTROMETER FOR STUDYING CRYSTALS UNDER HIGH HYDROSTATIC PRESSURE. A. F. Clark and D. F. Wait (Univ. of Michigan, Ann Arbor). Rev. Sci. Instr., 35: 863-6(July 1964).

A spectrometer for studying the effect of hydrostatic pressure to 10 kbar on the electron paramagnetic resonance spectra of crystals is described. A two-sample comparison method is used which greatly simplifies both the experimental procedure and the analysis. The pressure is purely hydrostatic, and the cavity coupling is readily adjustable from outside the pressure vessel. (auth)

29961 DEW-POINT HYGROMETRY BY THE USE OF RADIOACTIVE α SOURCE. Hisanobu Kobayashi. Sci. Papers Inst. Phys. Chem. Res. (Tokyo), 57: 169-72(Dec. 1963).

A new method of determining the dew-point has been devised on the principle that the absorption of α particles by the deposited dew weakens the ionization current. A disk, on which surface the dew is to deposit, is electroplated with a radioactive α source and an ionization chamber measures the ionization current, the intensity of which and the surface temperature of the disk are recorded against time. The temperature at which the current undergoes a rapid decrease and the temperature at which the current becomes minimum i.e., the dew begins to disappear, decide the correct dew-point. This method is free from the errors that arise from supersaturation of water vapor and incidental rise of disk temperature inherent in the mirror type hygrometer that necessitates illumination. The effects of wind, electric field, and atmospheric pressure are examined. (auth)

29962 LIQUID HYDROGEN FLOW MEASUREMENT. L. N. Mortenson and H. R. Wheelock. p.153-60 of "Institute of Environmental Sciences, 1964 Proceedings." Mt. Prospect, Ill., Institute of Environmental Sciences, 1964.

The mass flowmeter development program is summarized. The flowmeters evaluated, methods of evaluation, and test results are discussed. Several currently available flowmeters that can provide measurement accuracies on the order of ±0.5% with both single and two-phase flow conditions are covered, and the unique system developed for calibrating hydrogen flowmeters with an accuracy on the order of ±0.1% is described. (D.C.W.)

29963 ELECTRONIC METHODS. E. Bleuler and R. O. Haxby, eds. Methods of Experimental Physics. Volume 2. New York, Academic Press, 1964. 851p. $24.00.

Information is given on the technology of passive circuits and circuit elements; vacuum and gas-filled tubes; semiconductor circuit elements; rectifiers, amplifiers, and oscillators; servomechanisms; regulation and feedback; nonlinear circuits; microwaves; miscellaneous devices; and the uses of electronic methods for measurements of a broad range of quantities. (T.F.H.)

29964 PHYSICS OF FAILURE IN ELECTRONICS. VOLUME 2. M. F. Goldberg, ed. (Illinois Inst. of Tech., Chicago. IIT Research Inst.); and Joseph Vaccaro, ed. (Rome Air Development Center, Griffiss AFB, N. Y.). 1963. 568p. (AD-434329) $7.00(OTS)

A total of 21 papers were presented on prediction techniques, device substructures, experimental techniques, and devices at the Second Annual Symposium on the Physics of Failures in Electronics. Twelve additional papers are included. Topics included are: analysis of requirements in reliability physics, research toward a physics of aging of electronic components, a derivation of Delbruck's model for random failure for semiconductors, comprehensive failure mechanism theory of metal-film resistors, stress-strength theory in reliability functions, diffusion studies on Ta-Ta_2O_5 capacitors, thermal diffusion effects on degradation of semiconductor junction devices, failure mechanisms in silicon, failure mechanisms at insulator-conductor junctions, surface charge separation effects in silicon transistor failure, failure mechanisms in thin-film metal-dielectric structures, failure physics and accelerated testing, accelerated stress testing of germanium transistors, prediction of functional electronic block performance through localization of malfunctions, electron microprobe analysis of silicon switching diodes, burst noise in semiconductor devices, localized thermal effects in silicon power transistors, failure mechanisms in semiconductors, degradation of gallium arsenide tunnel diodes, aging mechanisms of metal film resistors, failure mechanisms in traveling-wave tubes, thermodynamics of failure and aging, flowgraph techniques in solutions of reliability functions, identification and elimination of a failure mechanism in semiconductor devices, reliability of gaseous optical masers, silicon surface passivation, missile failure due to impurities in electroplates, stacking faults and failure of silicon devices, failure modes and mechanisms in solid Ta capacitors, failure modes in microelectronic circuits, x-ray radiograph of failures in semiconductors, and a failure mechanism in tunnel diodes. (R.E.U.)

29965 USE OF LORAN-C IN DETECTION OF HIGH-ALTITUDE NUCLEAR EXPLOSIONS. Walter N. Dean (Sperry Gyroscope Co., Great Neck, N. Y.). 11p. (CONF-536-5)

From National Winter Convention on Military Electronics, Los Angeles, Feb. 1964.

High-altitude nuclear explosions have a marked effect on the D layer of the ionosphere. Loran-C, a 100-kc radio-navigation system in worldwide operation, provides a convenient signal source for detecting these effects. During the United States nuclear test series in 1962, three Loran-C skywave monitors were operated at distances up to 5000 miles from Johnston Island. All monitors observed pronounced changes in skywaves resulting from the high-altitude nuclear tests. This paper describes the effects observed and discusses their relationship to a possible worldwide system to detect high-altitude nuclear bursts. (auth)

Radiation Detection

Refer also to abstracts 29185, 30073, 30255, 30256, 30713, and 30768.

29966 (AECL-1960) THE USE OF GERMANIUM LITHIUM-DRIFT p-i-n DIODES AS HIGH RESOLUTION GAMMA-RAY SPECTROMETERS. G. T. Ewan (Atomic Energy of Canada Ltd., Chalk River, Ont.). Apr. 1964. 31p. (CONF-481-69)

From American Physical Society Annual Meeting, New York, Jan. 1964.

Lithium-drift germanium diodes were used to study γ-ray spectra from the x-ray region to 9 Mev. The resolution (FWHM) obtained at 122 kev was 3.1 kev and at 7285 kev was 9.8 kev. Intrinsic efficiency curves are given for an 18-mm diameter detector with a 3.5-mm depletion depth. A brief description is given of a 3-crystal pair spectrometer using a lithium-drift germanium diode as the central crystal. (auth)

29967 (AERE-R-4638) SCINTILLATION COUNTING OF TRITIATED WATER AND OTHER BETA-ACTIVE SOLUTIONS. A. K. Burt and J. A. B. Gibson (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). May 1964. 8p.

The sensitivity has been determined for four scintillation counting systems, liquid, plastic beads, plastic flow cell, and an anthracene filled flow cell. Aqueous solutions of tritium (i.e. tritiated water), carbon-14, caesium-137, chlorine-36, and strontium-90 plus yttrium-90 were examined in these investigations. The liquid scintillation and plastic bead systems were examined to fulfill the requirement for a sensitive, inexpensive counter for routine assay of beta-ray emitters. It was shown that with the liquid scintillation counter the limit of detection (two standard deviations of the mean background) is 19 pc/ml for tritium and 1 pc/ml for beta-ray emitters above 0.5 Mev. The plastic beads give comparable sensitivity for higher energy beta emitters. The two flow cells were examined for use with a continuous system for monitoring tritium by the extraction of water vapor from the air. The anthracene filled flow cell was found to have a background sensitivity for tritium of 13.3 nc/ml at an efficiency of 1.6%. (auth)

29968 (AFCRL-63-587) THE FERROUS-FERRIC DOSIMETER: A REVIEW. Edward A. Burke (Air Force Cambridge Research Labs. Laurence G. Hanscom Field, Bedford, Mass.). Dec. 1963. 21p. (AD-429156)

The characteristics, preparation, and use of the ferrous-ferric dosimeter are reviewed in detail. This includes a discussion of the dose range, dose rate dependence, energy dependence, and temperature effects. For photons with energies in excess of 6 kev, the irradiation yield may be represented by the expression $G = 15.61 - 15.43/E$, where E is the mean photon energy in kev and G is the number of ferrous ions oxidized per 100 ev of energy absorbed. Several methods of measuring ferric ion concentration are described, including the conventional spectrophotometric determination of ferric and ferrous ion and the very sensitive radiometric measurement of ferric ion. A concise summary of all the information necessary for routine application of this dosimeter is given. (auth)

29969 (AFOSR-4920(Paper 2)) SEMICONDUCTORES COMO DETECTORES DE RADIACIONES NUCLEARES. (Semiconductors as Radiation Detectors). Horacio E. Bosch (La Plata. Universidad Nacional). 30p.

The properties of P-N junctions for the detection and measurement of deuterons, alphas, fission fragments, and electrons are discussed. Detection mechanisms are discussed. (R.E.U.)

29970 (AWRE-NR-1/64) A HIGH-RESOLUTION SPHERICAL PROPORTIONAL COUNTER. P. W. Benjamin, C. D. Kemshall, and J. Redfearn (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). June 1964. 19p.

The counter is described that has a spherical cathode and a thin-wire anode along a diameter of the sphere. The field is made constant along the length of the anode by careful design of the supports and insulators. The resolution of the counter for monoenergetic particles is 4.7% at a gas gain of 20 and 12.2% at a gas gain of 2,000. (auth)

29971 (BNL-7894) DIGITIZED SONIC SPARK CHAMBER FOR OPERATION WITH COUNTER HODOSCOPE, DATA HANDLING SYSTEM AND ON-LINE COMPUTER. K. J. Foley, R. S. Gilmore, S. J. Lindenbaum, W. A. Love, S. Ozaki, E. H. Willen, R. Yamada, and L. C. L. Yuan (Brookhaven National Lab., Upton, N. Y.). Mar. 2, 1964. Contract AT-30-2-GEN-16. 13p. (CONF-560-1)

From Conference on Film-less Spark Chamber Techniques and Associated Computer Use, Geneva, Mar. 1964.

A sonic spark chamber system was developed for use on-line with a computer in experiments that yield relatively low background and event counting rates but require high spatial resolution. Tests were performed on various capacitor-type microphone designs, necessary digitization electronics, and a method of computation, and are discussed. (R.E.U.)

29972 (CEA-2396) APPLICATION DE METHODES STATISTIQUES A L'EXPLOITATION D'UN SPECTRE D'ENERGIE. (Application of Statistical Methods to the Treatment of an Energy Spectrum). Georges Friedling (France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucléaires, Cadarache). 1964. 15p.

A study was made of the possibility of improving the γ-neutron discrimination of a direct-current ionization chamber using as the signal not the mean value but the variance of the detector's exit current and the possibility of concentrating all the information contained in a simple spectrum made up of Gaussian curves into a small number of variables. (auth)

29973 (CERN-64-28) A PHOTO SCANNING AND MEASURING DEVICE. G. Kuhn (European Organization for Nuclear Research, Geneva). June 5, 1964. 38p.

A photo scanner was designed for measuring the X and Y coordinates of nuclear tracks on bubble chamber photographs and for converting the information into digital form on tape. The components that are described include the digitizer, scalers, puncher, typewriter, read-out, and auxiliary circuits. The operation of the circuit is also described. (D.L.C.)

29974 (CLOR/IBJ-II-25) LARGE-AREA HIGH-RESOLUTION SEMICONDUCTOR ALPHA SPECTROMETER. Janina Chwaszczewska (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw); Jerzy Roman, Zbyslaw Szwajy, and Zdzislaw Urbanowicz (Poland. Biuro Pelnomocnika Rzadu do Spraw Wykorzystania Energii Jadrowej. Centralne Laboratorium Ochrony Radiologicznej, Warsaw). 1963. 15p.

A semiconductor alpha spectrometer of 320 sq mm in sensitive area, with a mosaic of four silicon surface-barrier detectors and individual low-noise charge-sensitive preamplifiers is described. The spectrometer has a resolution width of about 40 kev for 5.3-Mev alpha particles at about −25°C. The background count is less than 1 count per day per channel in the energy range 4 to 9 Mev. The overall drift of the system is less than 20 kev per day and the linearity is within 1%. The high resolution, very low background count, and the simplicity of operation make the spectrometer ideally suited for low-level alpha spectrometry, particularly in biological materials. (auth)

29975 (COO-119-229(p.186-98)) HUMAN TOTAL BODY COUNTER CALIBRATION. R. D. Lloyd (Utah. Univ., Salt Lake City. Coll. of Medicine).

The calibration of a human whole-body radioactivity counter for ^{40}K, ^{137}Cs, and ^{131}I determinations is discussed. Cesium-132 was used to calibrate the counter for ^{137}Cs, and ^{42}K was used for ^{40}K in human volunteers. Fallout ^{131}I in milk was used as a source for calibration of counters for measurements of ^{131}I content in the thyroid and whole-body of man. (C.H.)

29976 (EANDC(US)-46U) U. S. FACILITIES FOR MAKING LOW-ENERGY NEUTRON CROSS SECTION MEASUREMENTS. John A. Harvey, comp. (European-American Nuclear Data Committee). Oct. 1963. 20p.

A compilation is presented of U. S. facilities and their specifications. Included are fast choppers, time-of-flight spectrometers, single-crystal, phased chopper rotating crystal, phased chopper velocity selector, and triple-axis crystal spectrometers. (R.E.U.)

29977 (JINR-P-1676) NEISPOLZOVANNYE VOZMOZHNOSTI CHERENKOVSKIKH SCHETCHIKOV POLNOGO VNUTRENNEGO OTRAZHENIYA. (On Some Possibilities of Total-Reflection Cherenkov Counters). V. P. Zrelov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1964. 12p.

Two possibilities of constructing total-reflection Cherenkov counters for well-collimated particle beams are treated. Both possibilities are based on a strong dependence of the direction of the Cherenkov radiation yield from the radiator upon the angle of the Cherenkov radiation, which is close to the total reflection one. The first possibility is concerned with a measurement of the refraction angle for the Cherenkov radiation on the radiator edge perpendicular to the direction of particle motion and the other possibility considers the case when the particles are traveling parallel to the radiator edges. (auth)

29978 (KFK-188) BERECHNUNG DES PHOTOBRUCHES ZYLINDRISCHER NaJ(Tl)-DETEKTOREN FUR KOLLIMIERTE GAMMASTRAHLUNG NACH DER MONTE-CARLO-METHODE. (Calculation of the Photo Fractions of Cylindrical NaI(Tl) Detectors for Collimated Gamma Rays by the Monte Carlo Method). C. Weitkamp (Kernforschungszentrum. Institut fur Angewandte Kernphysik, Karlsruhe, Germany). Dec. 1963. 31p.

The effect of the collimation of the incident radiation on the photo fraction was investigated by the Monte Carlo method for cylindrical NaI(Tl) crystals with dimensions between 3 $\phi \times 2$ in. and 5 $\phi \times 6$ in. and punctiform sources arranged at various distances from the detector surface on the crystal axis with energies between 0.2 and 10 Mev. The Compton effect and pair formation were rigidly calculated, but bremsstrahlung and electron losses were neglected. The results of the calculation are tabulated and show that the effect of the collimation is, in general, an enlargement of the photo fraction. (J.S.R.)

29979 (LNF-64/11) FENOMENI PROPAGATIVI NELLE CAMERE A SCINTILLA. (Propagation Phenomena in Spark Chambers). Note No. 237. M. A. Locci and M. Puglisi (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati). Apr. 14, 1964. 37p.

The correct operation of spark chambers is connected with the greater or smaller degree of isotropy that can be obtained in the chamber itself. Once the geometric isotropy has been reached, as much as required, it is necessary to find out the conditions which must be satisfied in order to obtain electrical isotropy. In the study of events with several contemporary charged particles, it is necessary to optimize the geometric and electrical isotropy conditions. The behavior of the electric field between the plates of a spark chamber is solved as a function of time and position considering the voltage waves that may propagate between the plates. The solution may be remarkably simplified if the hypothesis is made that the conducting sheets, of which the chamber is made, are rectangular in shape and that they are fed on the shorter side. If the width of the gap is small with respect to the sides of the plates, and the unfed side is much larger than the one that is connected to the generator, then it can be assumed that the propagation between the plates takes place only along the direction parallel to the longer side and thus the plates of the chamber can be represented by distributed line elements. (auth)

29980 (NAEC-AML-1854) INVESTIGATION OF THE OXALIC ACID CHEMICAL DOSIMETRY PROCEDURE FOR MEASURING GAMMA RADIATION. A. L. Glass (Naval Air Engineering Center. Aeronautical Materials Lab., Philadelphia). Jan. 13, 1964. 15p. (AD-428636)

An investigation of an oxalic acid chemical dosimetry procedure for determining high levels of gamma radiation emanating from a ^{60}Co source, is described. The procedure that is recommended is accurate and easily performed with common laboratory equipment. It can be utilized for the measurement of gamma radiation in the range of 1.6×10^6 to 6×10^7 rads. (auth)

29981 (NDL-TM-12) A MOBILE AUTOMATIC COUNTING FACILITY. John H. McNeilly (Army Nuclear Defense Lab., Edgewood Arsenal, Md.). May 1964. 26p.

The mobile automatic counting facility contains six scintillation counting units capable of performing alpha, beta, and/or gamma radiation measurements. The instrumentation is housed in a 38-foot semitrailer that allows the facility to be easily moved. The facility was used in many areas within and outside the continental United States; it has traveled approximately 70,000 miles during its 4 years of operation. During this period, the facility has proved to be efficient, reliable, accurate, and economical. (auth)

29982 (NP-13972) CONTADOR DE PULSOS. INFORME NO. 85. (Pulse Counter. Report No. 85). Omar Garcia and Manfredo Kopp (Argentina. Comision Nacional de Energia Atomica, Buenos Aires). 1963. 22p.

A pulse counter provided with G-M tubes and designed for industrial and medical applications is described. The polarization source for the detector tubes, counting unit, pulse integrator, and time measurer is included in one cabinet. The results of each measurement are given in integral form. The instrument is compact, simple to operate, and sturdy. The principal characteristics of the pulse counter are given. The theory of operation of the circuits used is briefly explained. The sources of the measurement errors are discussed. Instructions for the operation and maintenance of the counter are included. (tr-auth)

29983 (RFP-348) AN ALPHA COUNTER FOR GLOVE BOX OPERATIONS. W. H. Tyree and V. P. Johnson (Dow Chemical Co. Rocky Flats Div., Golden, Colo.). Aug. 15, 1963. Contract AT(29-1)-1106. 16p.

A transistorized counter, which indicates alpha contamination with a flashing light, is described. A charged capacitor is utilized to provide anode potential for an air proportional detector. (auth)

29984 (TID-20501) DEVELOPMENT OF A FIVE-INCH HIGH-SPEED PHOTOMULTIPLIER. Quarterly Re-

port No. 3, December 9, 1963–March 9, 1964. F. A. Helvy (Radio Corp. of America. Industrial Tube and Semiconductor Div., Lancaster, Penna.). Mar. 16, 1964. Contract AT(30-1)-3190. 9p.

The development of a five-inch high-speed photomultiplier with small transit-time spread, short pulse rise-time, uniform collection efficiency over a great fraction of the entrance window area, and low dark current is described. Five tubes served as test tubes for the parameters under investigation. Test results indicate that all specifications proposed probably can be met. (T.F.H.)

29985 (AEC-tr-6433) DEEP-SEA GAMMA-RAY MEASURING DEVICE. (Japan. Meteorological Agency, Tokyo). [nd]. 20p. (A translation). (Includes original, 17p.).

The design and operation of a "Riken"-type deep sea gamma measuring device are described. The instrument consists of a scintillation counter and a crystal clock for automatic recording on stylus paper of pulses and time increments. A NaI crystal and secondary electron multiplier tube (RCA 6199) are used with transistorized circuitry. Complete specifications and calibration are given. (R.E.U.)

29986 PHOTOCHEMICAL METHOD FOR X-RAY DOSIMETRY. G. Orban, J. Patko, and I. Berta (Kossuth Lajos Univ., Debrecen, Hungary). Acta Univ. Ludovico Kossuth Nom., 7: 53-9(1961).

Theoretical aspects of chemical dosimeter development and applications are discussed. Requirements for chemical methods applied to measurement of radiation doses are enumerated. A simple chemical dosimeter was developed for determining dose values in deep therapy. A mixture of carbon tetrachloride and alcohol was used for a radiosensitive substance. The effect produced by the alcohol concentration on the quantity of HCl formed by radiation was studied. Best results were obtained with a concentration of 90% CCl_4 and 10% alcohol. An investigation of the amount of HCl produced by increasing dose in this dosimeter system revealed an exponential relation, but, by using a specially sensitized CCl_4, in the 0 to 50 r dose interval a linear correlation was obtained. With various types of radiation, determinations were made of G, the yield value of the system, expressed as the number of molecules transformed by the energy absorbed for each 100 ev per g. The G value was 806 for 1000 r of 170-kv x radiation. To avoid pH meter measurements a slightly less accurate modification is offered in which an indicator dye (bromocresol green, 0.09 mg/ml) is added to the test solution to show the amount of hydrochloric acid released. A table shows the color changes observed at doses from 0 to 300 r. No spectral dependency of this system was found from measurements were carried out in the range of 100 to 170 kv. With a pH meter, doses of deep x-ray therapy can be measured with an accuracy of 1 to 10 r, depending on the pH meter used. By means of appropriately adjusted indicator solutions the threshold values also can be determined. The procedure is simple, uses inexpensive reagents, and easily interpreted. (BBB)

29987 APPLICATION OF SEMICONDUCTOR COUNTERS TO THE SPECTROMETRY OF ALPHA PARTICLES. Rafael Gaeta (Junta de Energia Nuclear, Madrid). Anales Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 60: 37-44(Jan.-Feb. 1964). (In Spanish)

An alpha spectrometer using a solid state detector was arranged to achieve an effective resolving power of 21 kev. The detector and the electronic instruments are commercially available. Experimental conditions for study of low-activity α emitters were analyzed. Results for α spectra of ^{235}U are given. (auth)

29988 A NEW METHOD FOR ABSOLUTE DETERMINATION OF THE ACTIVITY OF WEAK β-EMITTERS WITH THE LIQUID SCINTILLATION COUNTER. G. Wangermann (Institut für Angewandte Radioaktivität, Leipzig). Atomkernenergie, 9: 187-9(May-June 1964). (In German)

Absolute determination of the activity of weak β emitters by the Belcher extrapolation method was concluded to consider only insufficiently the form of the nuclear spectra. By comparison of the differential pulse height distributions of ^{35}S in various scintillator geometries it was possible to find conditions under which nuclear spectra and pulse height distributions are formally identical in certain energy limits. This fact was used for energy calibration of the voltage range of a threshold value discriminator. The activity was calculated by comparison of the identical partial area under the differential pulse height distribution with the total area under the nuclear spectrum. (auth)

29989 MEASUREMENT OF WEAK β-RAYS BY MEANS OF A LIQUID SCINTILLATION SPECTROMETER. F. Ritzl, Ingrid Janz, and Gisela Hoeschler (Kernforschungsanlage, Jülich, Ger.). Atomkernenergie, 9: 199-200(May-June 1964). (In German)

A survey is given concerning the determination of low-energy β emitters by means of a liquid scintillation spectrometer. The counting of tritium in organic and aqueous solutions is described. Various scintillation systems, those with a high "figure of merit" or with a good counting efficiency, are reported. Experiences in measuring the tritium content of protein-containing materials and of insoluble substances are described. A procedure is described for counting thin-layer chromatograms in a liquid scintillation spectrometer having a high counting efficiency. (auth)

29990 REMARKS ON UTILIZATION OF RESONANT DETECTORS. J. Brisbois and C. Hyver. Bull. Inform. Sci. Tech. (Paris), No. 81, 21-6(Mar. 1964). (In French)

After recalling theoretical and practical ideas useful for an understanding of the problem, the different methods making it possible to reach the intermediate fluxes when their spectrum is unknown were examined. The possibilities of extending the normal use of resonant detectors, and the limits of the different methods are discussed.

29991 SPECTROMETRY USING HYDROGEN AND HELIUM-3 PROPORTIONAL COUNTERS. C. Beets (CEN, Mol, Belg.) and R. Werz. Bull. Inform. Sci. Tech. (Paris), No. 81, 57-9(Mar. 1964). (In French)

Proportional counters permit direct measurement of the energy of ionizing particles; its application to neutron spectrometry is possible through the use of a nuclear interaction. The problems and developments in fast-neutron spectrometry using a hydrogen- or ^{3}He-filled proportional counter are discussed. (auth)

29992 FAST NEUTRON SPECTROMETRY USING SURFACE-BARRIER JUNCTIONS AND LITHIUM-6. J.-P. Noel, S. Passe, C. Beets, S. De Leeuw, and G. Gierts. Bull. Inform. Sci. Tech. (Paris), No. 81, 61-74(Mar. 1964). (In French)

Fast neutron spectra were studied by means of ^{6}Li covered surface barrier junctions, by two methods. First, the neutron spectrum was derived from the triton spectrum by use of the values of the differential reaction cross sections. Second, the energy conservation law $En = E\alpha + E_{H3} - Q$ was used. An experimental result is given for each method. (auth)

29993 SPECTROMETRY USING SCINTILLATORS. R. Laguerre. Bull. Inform. Sci. Tech. (Paris), No. 81, 75-6(Mar. 1964). (In French)

Present trends in fast-neutron spectroscopy using scintillation counters in nuclear reactors are discussed. The possibilities of developing an apparatus for distinguishing between pulses due to gamma rays and neutrons by the difference in their shapes are described. (auth)

29994 FAST NEUTRON SPECTROMETRY USING THRESHOLD DETECTORS. J. Comera and S. Sapena. Bull. Inform. Sci. Tech. (Paris), No. 81, 77-80(Mar. 1964). (In French)

An outline is given of analytical methods for tracing fast neutron spectra from information provided by threshold detectors. The main disadvantages are discussed along with a calculation, now under way, which may make it possible to choose more judiciously the method of analysis employed for the results. (auth)

29995 ABSOLUTE MEASUREMENTS, REACTIONS USES, AND PREPARATION OF DETECTORS. J. Brisbois, J.-L. Campan, A. Charbonnel, M. Lott, G. Pleyber, and M. Thierry. Bull. Inform. Sci. Tech. (Paris), No. 81, 81-4(Mar. 1964). (In French)

The various substances now being used for fast neutron measurements are given. Values of the constants used in analysis of the measurements are given for some. The methods are described which transform these constants for use both for irradiation and for counting. (auth)

29996 USE OF SILICON DIODES FOR STUDYING THE EFFECT OF FAST AND INTERMEDIATE NEUTRONS ON REACTOR SHIELDING. P. Dulieu, J. C. Lanore, and R. Schuttler. Bull. Inform. Sci. Tech. (Paris), No. 81, 93-9(Mar. 1964). (In French)

Two methods devised to determine experimentally the fluxes responsible for radiation damage in reactor shielding by means of silicon diode detectors are described. (auth)

29997 ASINI: A PROGRAM FOR INVESTIGATING AUTOMATIC SCANNING OF BUBBLE CHAMBER PHOTOGRAPHS. I. De Lotto, A. Ghirardi, and A. Grasselli (CISE, Milan). Calcolo, 1: 1-18(Dec. 1963). (Reprint No. 419)

A program for investigating the capabilities of automatic scanning of bubble chamber photographs is described. The program consists of two routines: the first (PHOTO) simulates the operation of a film-reading device; the second (ASINI: Automatic Scanning and Identification of Nuclear Interactions) identifies the tracks on the pictures simulated by PHOTO. Experimental results indicate the possibility of practical implementation of the proposed recognition method. (auth)

29998 BACK-BIAS CIRCUITS FOR MULTICHANNEL ANALYZERS. F. Grianti, P. F. Manfredi, and A. Rimini (CESNEF, Milan). Energia Nucl. (Milan), 11: 258-62 (May 1964).

The problem of obtaining good linearity performances from a back-bias circuit is examined. Some conventional diode back-bias circuits are reviewed. A new circuit which makes use of nonlinear operational feedback is introduced as an improvement of simple diode circuits. Linearity performances of all these circuits are compared with those of back-bias circuits based on the principle of linear subtraction. (auth)

29999 CONSTRUCTION OF SILICON SURFACE BARRIER DETECTORS WITH DEEP SENSITIVE VOLUME. G. Fabri and G. Redaelli (CISE, Milan). Energia Nucl. (Milan), 11: 276-7(May 1964).

By a process of liquid-phase weak compensation of boron impurities in p-type silicon at high resistivity, n-type silicon single crystals were prepared with resistivities up to 26,000 Ω cm, minority carrier lifetime of about 1 msec, and etch pit density of the order of $10^4/cm^2$. Surface barrier detectors were constructed from this material; current vs voltage characteristics of some of these detectors are presented, along with sample pulse height spectra. (M.J.T.)

30000 GENERAL PURPOSE FOUR-CHANNEL DIFFERENTIAL DELAY ANALYSER. S. A. Khan (Regional Research Lab., Hyderabad, [India]). Indian J. Pure Appl. Phys., 2: No. 5, 163-5(1964).

A four-channel differential delay analyzer of simple design for plotting decay curves of phosphors is described. Provision is made in the design for adding additional channels as required. The instrument can also be used for the study of the decay of short-lived radioisotopes and for the measurement of varying frequencies. The channel width for each channel is 100 μsec and can be reduced down to 5 μsec with suitable choice of the circuit components. (auth)

30001 THE MEASURABILITY OF SMALL GAMMA DOSES WITH PHOTOGRAPHIC FILMS AND PHOSPHATE GLASSES. K. Becker (Kernforschungsanlage, Julich, Ger.). Kerntechnik, 6: 199-203(May 1964). (In German)

Sensitivity and factors influencing the accuracy of a highly sensitive dosimeter film and low-predose dosimeter glasses were compared. Under practical climatic and time conditions in routine dosimetry it is now possible to measure smaller gamma doses with higher accuracy by the correct use of suitable glasses instead of films. (auth)

30002 THE CONTINUOUS BETA-GAMMA-PHOTOMETER FOR THE SUPERVISION OF FISSION PROCESSES AND ITS LIMITS OF APPLICATION. K. H. Waechter (Frieseke and Hoepfner GmbH, Erlangen, Ger.). Kerntechnik, 6: 245-8(June 1964). (In German)

A survey of the physical principles of beta-gamma photometry is followed by the description of an instrument for the continuous performance of the method. The possible sources of error of this instrument are examined. (auth)

30003 MEASUREMENT OF RADIOISOTOPES OF SMALL β ENERGY WITH LIQUID SCINTILLATOR. I. AN ELECTRON MULTIPLIER COUNTER FOR INVESTIGATING PHOSPHORESCENCE. Gyoergy Ormos and Piroska Fodorné Csányi. Magy. Kem. Folyoirat, 69: 198-203(May 1963). (In Hungarian)

The measuring principles of liquid scintillator counters for radioisotopes of small beta energies at 10°C were investigated. The manufactured cell showed a strong phosphorescence effect according to measurements, which near 1600 v and 250-fold intensification yielded a large counting rate, which diminished very slowly, and also after some hours was still too high (several thousand pulse/100 sec) to carry out the measurement series satisfactorily. The cell constructed with reflecting aluminum layers yielded, after an hour in darkness under the described conditions, 300 to 400 phosphorescence pulses/100 sec. For measuring the solvent phosphorescence the relation between the phosphorescence and the purity of the toluene was investigated. The noise of the electron multiplier and the cell and solvent phosphorescence gave together an error value of about 2800 pulses/100 sec. The necessary one hour waiting time in darkness limited the number of ^{14}C- or ^{35}S-containing samples measurable in one day to 3 or 4. Tritium-containing samples had to be held in darkness

for 10 to 12 hours before measurement. Possibilities of decreasing the temperature to decrease the noise and increasing the number of measurements that can be carried out in a day by using a filter to absorb the phosphorescence or by using a sample change are discussed. (tr-auth)

30004 A DETECTOR FOR EXAMINING LARGE CONTAMINATED SURFACES. Daniel Voedroes and Gyoergy Gyenge (MTS Orvos-Radiologiai Kutatőesoport, Budapest). Magy. Radiol., 15: 247-9(Aug. 1963). (In Hungarian)

Modifications of existing detectors in Hungary for monitoring purposes are described. Diagrams of instruments and circuits are included. (H.M.G.)

30005 A METHOD FOR IMPROVING THE ACCURACY OF DOSIMETER. Kōmyō Kariya (Ritsumeikan Univ., Japan) and Hiromichi Kurosawa. Nippon Genshiryoku Gakkaishi, 6: 206-11(Apr. 1964). (In Japanese)

A digital type dosimeter was developed and its characteristics studied. The digital type dosimeter is composed of a small G-M counter, control circuit, counter voltage supply, electronic scaler, mechanical register, and battery. For miniaturization, micromodule circuits, a watch mechanism, and a Ni-Cd-Al cell are used. To reduce the power consumption, the counter voltage is controlled by the counting rate. The maximum measuring range is 5 r, and the indicating and the alarm level can be set from 0.012 mr to 5 r. The size is 150 × 90 × 50 mm and the weight is 500 g. (auth)

30006 DESCRIPTION OF A SCINTILLATION DOSIMETER. W. Szymczyk and Z. Drejak (Inst. of Oncology, Krakow). Nowotwory, 13: 281-5(1963).

A description is presented of a scintillation dosimeter with indications from 0 to 100° per hour independently of the energy and direction of radiation. The instrument is adapted for measuring doses in the rectum in gynaecological patients treated by radium. (Excerpta Med., Sect. XXIII, 1: No. 3, (March 1964)).

30007 MEASUREMENT OF HIGH SPECIFIC ACTIVITY, AQUEOUS SOLUTIONS WITH GEL-SCINTILLATORS. H. Spenke (Institut für Radiumforschung und Kernphysik, Osterreichische Akademie der Wissenschaften, Vienna). Nucl. Instr. Methods, 26: 201-4(Mar. 1964). (In German)

Two gel-scintillators, one based on Al-stearate, the other on SiO_2, are compared. The more advantageous Al-stearate-gel was used for β spectroscopy and β-absolute-counting of aqueous samples with high specific activity. The results of a half life determination of Tl-204 with the Al-stearate-gel are 3.72 + 0.1 y and 3.84 + 0.1 y, respectively. (auth)

30008 PREPARATION OF HIGH-RESISTIVITY SILICON SURFACE-BARRIER DETECTORS FOR USE AT LARGE REVERSE BIAS VOLTAGES. E. D. Klema (Northwestern Univ., Evanston, Ill.). Nucl. Instr. Methods, 26: 205-8(Mar. 1964).

Surface-barrier detectors were fabricated with high-resistivity n-type silicon (4000 – 20000 ohm • cm) which can operate at reverse biases up to 4000 volts with good energy resolution at room temperature. The best energy resolution obtained with a depletion region deep enough to stop 1-Mev electrons is 13.2 kev for a detector of 8 mm diameter. The best resolution at very high reverse bias is 22.4 kev at 3800 volts bias for a detector of 7 mm diameter. The deepest depletion region obtained is 3.5 mm with a 6 mm diameter 20000 ohm • cm unit operating at 1800 volts reverse bias. Under these conditions the measured energy resolution for 1-Mev electrons is 35 kev. The conditions necessary for the production of surface barriers capable of withstanding these biases with low noise and low leakage current are discussed in detail. (auth)

30009 DEAD TIME CORRECTIONS ON MEASUREMENTS OF SHORTLIVED ACTIVITIES. Kerstin Lowe (Research Inst. of National Defence, Stockholm). Nucl. Instr. Methods, 26: 216-18(Mar. 1964).

The γ-spectrometric measurements at high counting rates of a short-lived nuclide, both the measuring time and the dead time of the analyzer may be of the same order of magnitude as the half life of the nuclide. The percentage dead time then varies during the measurement. This has to be accounted for when estimating the point of time to which the measurement should be referred. (auth)

30010 ON THE ILLUMINATION OF MULTIPLATE CLOUD CHAMBERS. R. M. Bull, W. F. Nash, and B. C. Rastin (Univ. of Nottingham, Eng.). Nucl. Instr. Methods, 26: 263-6(Mar. 1964).

An important consideration in the design of multiplate cloud chambers is the provision of adequate illumination. In particular it is essential to obtain reasonably uniform illumination of droplets irrespective of their position in the chamber. This consideration ultimately imposes limits on the minimum separation of the plates, the nature of their surfaces, and the optical geometry and location of the light source. Expressions are derived indicating the effect on the uniformity of illumination due to these factors assuming an illumination system with cylindrical geometry. These expressions were evaluated for some cases of practical interest and are presented graphically. (auth)

30011 METHOD FOR ALIGNMENT OF A SHORT MAGNETIC LENS BETA RAY SPECTROMETER BY UTILIZING IMAGE ROTATION. W. Buehring, H. Rebel, and G. Schatz (Universität, Heidelberg). Nucl. Instr. Methods, 26: 267-8(Mar. 1964).

A simple method for aligning short magnetic lens beta ray spectrometers is described. (auth)

30012 AN EIGHT-DIMENSIONAL PULSE-HEIGHT ANALYZER. R. Littauer and L. Tepper (Cornell Univ., Ithaca, N. Y.). Nucl. Instr. Methods, 26: 285-94(Mar. 1964).

An eight-dimensional pulse-height analyzer with 30 channels per dimension is described. This is a relatively slow instrument designed for use with high energy physics experiments. The pulse inputs may accept signals directly from particle detectors using high speed photomultipliers; a 30 nsec linear gate is provided for selection of acceptable events in synchronism with an external trigger pulse. Data output is by electric typewriter and on punched IBM cards. (auth)

30013 THE PROBLEM OF DOSE SENSITIVITY OF SCINTILLATION COUNTERS FOR GAMMA RAYS. G. G. Nentwig and K.-H. Weber (VEB Vakutronik WIB, Dresden). Nucl. Instr. Methods, 26: 295-300(Mar. 1964). (In German)

The dose sensitivity of scintillation counters with thin plastic scintillators is calculated as a function of gamma ray energy. There are two components of efficiency: The first is due to secondary electrons generated in the scintillator, the second due to electrons produced in the absorber. These components show an inverse dependence on energy. Appropriate selection of the effective atomic numbers and the thickness of scintillator and absorber and suitable selection of the discriminator energy produce a dose sensitivity depending only moderately upon the quantum energy within a certain range. The experimental

examination of the theoretical considerations results in an average dose sensitivity of 16 counts/μr cm^2 ±20% within an energy range from 0.17 up to 1.25 Mev in the case of a PBD-plastic scintillator (50 mg/cm^2 thick) in combination with an aluminium absorber (350 mg/cm^2 thick). The discriminator energy has an optimal value of about 50 kev. (auth)

30014 TRANSISTORIZED TIME-AMPLITUDE CONVERTER. P. Vergezac and J. Kahane (Collège de France, Paris). Nucl. Instr. Methods, 26: 317-19(Mar. 1964). (In French)

The time-to-pulse height converter is described, more specially designed for time-of-flight spectrometry, provides measurements of time interval between two negative 300-mv pulses. This apparatus appears to be linear up to 100 ns, with a better than 0.1 ns resolution; the overall resolution depends on the input pulses characteristics. (auth)

30015 A THREE-CRYSTAL NaI(Tl) GAMMA RAY SCINTILLATION SPECTROMETER. Y. Kalish and E. Nardi (Soreq Research Establishment, Rehovoth, Israel). Nucl. Instr. Methods, 26: 329-32(Mar. 1964).

A three crystal NaI(Tl) gamma ray scintillation spectrometer was constructed and tested. It is used as a Compton, anti-Compton and as a pair spectrometer. The main advantage of this spectrometer is its special geometry which leads to relatively higher efficiencies for the Compton and pair spectrometers as well as to a simple anti-Compton spectrometer. (auth)

30016 A REACTION CHAMBER FOR MEASUREMENTS OF COMPLEX NUCLEAR REACTIONS. D. Dehnhard and P. Kramer (Universität, Marburg, Ger.). Nucl. Instr. Methods, 26: 337-9(Mar. 1964). (In German)

For investigations of complex nuclear reactions of the type $A + a \rightarrow C^* \rightarrow b_1 + b_2 + b_3$ a versatile reaction chamber was constructed using one semiconductor detector Z_1 in coincidence with four detectors $Z_2^1 - Z_2^4$. The latter detectors are mounted in a plane containing the target, being 30° apart from one another. By two rotations around different axes, which intersect at the target, detector Z_1 can be moved to any point of a hemisphere, maintaining constant solid angle with respect to the target. Similarly, Z_2^1 can be brought to the opposite or to any other point of the other hemisphere. By a third rotation, the plane containing the detectors $Z_2^1 - Z_2^4$ can be rotated around an axis connecting Z_2^1 and the target center. All rotations can be made without breaking the vacuum. In connection with two-parameter-analyzers, this arrangement is particularly suited for investigations of reactions with three particles in the final state. The distribution of events in the X, Y-plane gives almost directly the generalized Dalitz-plot of the reaction. (auth)

30017 ON THE USE OF SAMPLING OSCILLOSCOPES WITH NON-PERIODIC, RANDOM-AMPLITUDE SIGNALS. M. Martini and G. Zanarini (Università, Bologna). Nucl. Instr. Methods, 26: 343-4(Mar. 1964).

The circuitry of oscilloscopes used to examine the shape of non-periodic, random-amplitude fast pulses supplied by elementary particle detectors is discussed. The conditions that must be satisfied by the circuitry are outlined, and satisfactory circuitry is proposed. (C.E.S.)

30018 THE APPLICATION OF BETA-GAMMA COINCIDENCE METHODS TO RADIOISOTOPES WITH COMPLEX DECAY SCHEMES. P. J. Campion (National Physical Lab., Teddington, Middx, Eng.). Nucl. Instr. Methods, 26: 356(Mar. 1964).

It is shown that a 4π β-γ coincidence apparatus, a gas flow counter operated at atmospheric pressure, is not adequate for complex decay schemes. The counter cannot discriminate between beta particles of different energies due to its geometry and operating conditions. These detectors have a considerable sensitivity to γ rays and rather large corrections would be necessary to allow for this effect. (C.E.S.)

30019 AN ELECTRON SCINTILLATION SPECTROMETER. B. Persson (Univ. of Lund, Sweden). Nucl. Instr. Methods, 27: 1-9(Apr. 1964).

The capability of an end-window type electron scintillation spectrometer for measuring continuous β-spectra was investigated. An anthracene detector operated with a collimator in hydrogen was found to produce β-spectra quite well in the investigated energy region (0.15–2.2 Mev). The corrections required were studied in some detail and are compared both with previous measurements on back scattering of electrons and with a theoretical calculation of the scattering of electrons by the surrounding hydrogen. (auth)

30020 PULSE-SHAPE DISCRIMINATION METHOD FOR PARTICLE IDENTIFICATION. Gy. Máthé and B. Schlenk (Inst. of Nuclear Research, Hungarian Academy of Sciences, Debrecen). Nucl. Instr. Methods, 27: 10-12(Apr. 1964).

An electronic method for pulse shape discrimination is described, which was applied for identification of various charged particles. By using a single crystal scintillation spectrometer with CsI(Tl) crystal, the variation of the fluorescent decay time with the alpha and proton energy was obtained. (auth)

30021 PULSE HEIGHT-ENERGY RELATIONS FOR ELECTRONS AND ALPHA PARTICLES IN A LIQUID SCINTILLATOR. K. F. Flynn, L. E. Glendenin, E. P. Steinberg, and P. M. Wright (Argonne National Lab., Ill.). Nucl. Instr. Methods, 27: 13-17(Apr. 1964).

The response of liquid scintillator solutions to alpha particles in the energy range from 0.8 to 8 Mev and electrons in the energy range from 0.022 to 1 Mev was investigated. The observed pulse height-energy relations are in good agreement with data reported for organic crystals and plastic scintillators. The results indicate a pronounced nonlinearity for alpha particles over most of the energy range and a nonlinearity for electrons below about 100 kev. For electrons above 100 kev a linear relation with a positive energy intercept of 20 kev is obtained which appears to be applicable to all organic scintillators. (auth)

30022 A FLOW-BUTANE PROPORTIONAL COUNTER AS AN INTEGRAL DETECTOR. J. Kern (Université, Fribourg, Switzerland). Nucl. Instr. Methods, 27: 18-22 (Apr. 1964). (In French)

The construction, operation, and performance of a flow-butane proportional counter is described. It is shown that in accordance with the increase of the dead time and anode tension, the slope of the plateau is smaller at high than at low counting rates. A useful plateau (200 v length, 0.8% slope for ΔV = 100 v at 800 c/sec) was obtained with a gas pressure as low as 27 torr. These characteristics improve with higher pressure. (auth)

30023 ON THE VOLTAGE DISTRIBUTIONS FOR PHILIPS 56 AND 58 AVP PHOTOMULTIPLIERS. G. Bellettini (Istituto Nazionale Fisica Nucleare, Pisa, Italy and Universita, Pisa, Italy), C. Bemporad, C. Cerri, and L. Foa. Nucl. Instr. Methods, 27: 38-40(Apr. 1964).

Two standard voltage distributions, differing from those recommended by the manufacturers, to be used for Philips

56 and 58 AVP photomultipliers in conditions of high gain or of high linearity were determined. There is considerable improvement in gain or in linearity obtained with such distributions as compared with those recommended by the manufacturers. An apparatus for independently varying the interdynode voltages is described, with which the optimum distributions for any particular photomultiplier can be found. (auth)

30024 A FAST-NEUTRON TIME-OF-FLIGHT SPECTROMETER. G. C. Bonazzola and E. Chiavassa (Istituto Nazionale di Fisica Nucleare, Turin). Nucl. Instr. Methods, 27: 41-4(Apr. 1964).

A fast-neutron, time-of-flight spectrometer is described, which uses the neutrons from the reaction $^{3}H(d,n)^{4}He$ and the method of the associated α particle. It features a fast gate situated in the start channel before the time-to-amplitude converter. The stability over a period of many days is of the order of 10^{-10} sec, equal to its electronic resolution time. (auth)

30025 A SLOW NEUTRON CHOPPER TIME-OF-FLIGHT SPECTROMETER AT THE REACTOR R2 IN SWEDEN. S. Holmryd, K. Skoeld, E. Pilcher, and K. E. Larsson (Aktiebolaget Atomenergi, Stockholm). Nucl. Instr. Methods, 27: 61-8(Apr. 1964).

A slow neutron time-of-flight spectrometer for studies in solid and liquid state physics was constructed at the light water moderated reactor R2. The thermal spectrum emerging from the used channel was measured and found to be a Maxwellian. The spectrometer has a semi-monochromatizing chopper working in conjunction with a beryllium filter. The transmitted neutron spectrum has a half value width of ≈ 0.3 Å at 4 Å. The time resolution corresponds to 12 μsec/m or 1.2% at 4 Å. (auth)

30026 THE PERFORMANCE OF Au–Si SURFACE BARRIER DIODE AS A BETA RAY DETECTOR. S. K. Sen (Univ. of Manitoba, Winnipeg). Nucl. Instr. Methods, 27: 74-6(Apr. 1964).

Pulse height spectra for ^{134}Cs and Th (B + C + C'') were obtained. The conversion line energies were determined and compared with other determinations. The results indicate linear response of the detector from 150 to 1300 kev. The internal conversion coefficients of ^{134}Cs were also obtained and compared with theoretical values. (D.C.W.)

30027 CALCULATION OF THE TIME VARIATION OF SCINTILLATION PULSE COUNTERS. H. Jungclaussen (Zentralinstitut für Kerforschung, Rossendorf, Ger.). Nucl. Instr. Methods, 27: 88-92(Apr. 1964). (In German)

The relation between the energy resolution and time resolution of a scintillation counter is discussed. Formulas for the approximate calculation of the resolving time are derived. Especially, coincidence circuits with double pulseshaping and those with variable threshold are considered. In both cases the influence of the fluctuations of the electron transit-time and of the amplifier cutoff frequency are essentially small and, therefore are neglected in the calculations. (auth)

30028 AN AUTOMATIC DEVICE FOR THE ANALYSIS OF SPARK CHAMBER PICTURES. I. M. Blair, G. Conforto, C. Rubbia, B. Smith, and E. Zavattini (CERN, Geneva). Nucl. Instr. Methods, 27: 93-103(Apr. 1964).

An automatic film scanner designed for analysis of spark chamber photographs of the $\pi^- + p \rightarrow \pi^- + \pi^+ + n$ interaction just above threshold is described. It can operate on line with a computer or separately. The results of some measurements are included. (D.C.W.)

30029 A UNIVERSAL SEQUENCE CONTROL UNIT FOR A WILSON CLOUD CHAMBER. J. P. Van der Merwe (Potchefstroom Univ. for C.H.E., Republic of South Africa). Nucl. Instr. Methods, 27: 139-40(Apr. 1964).

A system is described with which any number of operations can be started and stopped at any instant after the occurrence of the trigger pulse, with an accuracy of 99% on the time intervals involved. The time duration of each operation can be altered without affecting the other operations. The unit is particularly suitable for use with a Wilson cloud chamber, but may have more universal application. (D.C.W.)

30030 A TWO CRYSTAL COINCIDENCE GAMMA RAY SPECTROMETER USING A SOLID STATE DETECTOR. A. McG. Beech, J. K. Parry, and D. F. Urquhart (Australian Atomic Energy Commission, Sydney). Nucl. Instr. Methods, 27: 169-71(Apr. 1964).

A spectrometer is described which uses a two-crystal coincidence arrangement to reduce the Compton background and which has a resolution of 14 kev and a peak efficiency of 40% for ^{137}Cs. A silicon surface barrier diode is used as the primary detector; an annular plastic scintillator detects the backscattered photons. (D.C.W.)

30031 RADIATION DAMAGE EFFECTS IN SEMICONDUCTOR DETECTORS. Geoff Dearnaley (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nucleonics, 22: No. 7, 78; 80; 84-5(July 1964).

The nature, effects, and processes of radiation damage in silicon detectors are briefly discussed using both experimental and theoretical observations. Limits imposed on the use of silicon detectors by radiation damage are also considered. (D.C.W.)

30032 NUCLEATION PROCESSES IN BUBBLE CHAMBERS AND ULTRASONIC CAVITATION. M. Bertolotti and D. Sette (Università, Rome and Istituto di Ultracustica CNR, Rome). Nuovo Cimento (10), 32: 1182-90 (June 1, 1964).

Experimental evidence was found that cosmic neutrons may be at the origin of ultrasonic cavitation in water through the creation of microbubbles; oxygen nuclei of water knocked-on by neutrons would act as nucleating agents. This phenomenon is analogous to that of bubble chamber operation. The Glaser and Seitz theories on the operation of this device seem inadequate to explain directly ultrasonic cavitation and would need appropriate extensions. The phenomena are considered from another point of view using a statistical description of the status of the molecules in the region interested by the penetrating particle. The applications of this new formulation to bubble chamber and cavitation are presented. (auth)

30033 ON THE MEASUREMENT OF IONIZATION IN HYDROGEN BUBBLE CHAMBERS. C. Dilworth (CERN, Geneva), D. R. O. Morrison, and G. Mambriani. Nuovo Cimento (10), 32: 1432-44(June 1, 1964).

An account is given of measurements of ionization in bubble chamber by bubble counting, gap-counting, and gap-length techniques. The relative advantages of these techniques and their validity in given experimental conditions are discussed. The variation of mean gap-length as a function of velocity of the particle is determined and compared with previous investigations. (auth)

30034 ON THE CHARACTERISTICS OF MULTICHANNEL PULSE HEIGHT ANALYZER. [Part] 1. Komyo Kariya (Ritumeikan Univ., Kyoto). Oyo Buturi, 31: 893-908(1962). (In Japanese)

The analytical method for finding the element identity and the dose using radiation spectrum patterns is convenient, requiring no complicated chemical processes. The apparatus of two types is used—the single-channel pulse height analyzer and the multichannel pulse height analyzer. The latter is made up of a scintillation detector, a linear amplifier, an A-D converter, a digital computer, a readout circuit, a power supply, and other circuits. In the course of years 1956 to 1959, transistorization of 100-channel and 400-channel pulse height analyzers was carried out, and their respective parts were studied. The analyzers have good linearity within 1% of deviation for radiation energy, stability within 1%/day of fluctuation, and dead time of (28 + 0.5N) μsec. Particulars of these analyzers are given. (auth)

30035 ON THE CHARACTERISTICS OF MULTICHANNEL PULSE HEIGHT ANALYZER. [PART] 2. Komyo Kariya (Ritumeikan Univ., Kyoto). Oyo Buturi, 32: 41-7(1962). (In Japanese)

The accuracy of a multichannel pulse height analyzer is dependent on the characteristics of its components; especially important are the linearity of A-D conversion, the stability of the digital computer, and the linearity of the linear amplifier and D-A conversion. The first two have a large influence on the linearity and resolving time with respect to radiation energy, the durable stability of channels, the dead time, and the number of available channels. The 100 and 400 channel pulse height analyzers reported previously were examined for these characteristics. (auth)

30036 RESOLVING TIME OF G.M. COUNTERS AND ITS RELATION TO INPUT RATE. H. Lindeman and E. Mornel (Israel Inst. of Tech., Haifa). Physica, 30: 969-77(May 1964).

Using scaling-factor statistics and an interval counting circuit, the resolving time of G-M counters was determined for input rates between several hundred and several thousand counts per second. The experiments proved that the resolving time of a given counter, for a given sensitivity of the recording apparatus, is independent of the input rate and that the counting loss formula $N^* = N/1 + N\tau$ is correct for G-M counters. The latter fact was confirmed by measurements using the two-source method. Finally, by means of special oscillographic display, it was shown that the resolving time depends strongly on the sensitivity of the recording apparatus. (auth)

30037 DETERMINATION OF CYCLOTRON FAST NEUTRON SPECTRA AND FLUXES WITH ACTIVATION DETECTORS. I. Heertje and A. H. W. Aten, Jr. (Instituut voor Kernphysische Onderzoek, Amsterdam). Physica, 30: 978-84(May 1964).

Eight threshold detectors were used to determine the neutron fluxes and energy distributions obtained by bombarding various thick targets with 26-Mev deuterons. (auth)

30038 APPLICATION OF MAGNETIC SPECTROMETER WITH DOUBLE FOCUSING FOR REGISTERING A WIDE RANGE OF ELECTRON SPECTRA. N. G. Afanasev, A. V. Vysotskaya, V. A. Goldshtein, and V. I. Startsev (Inst. of Physics and Tech., Ukrainian SSR). Pribory i Tekhn. Eksperim., No. 2, 24-8(Mar.-Apr. 1964). (In Russian)

A magnetic spectrometer with a homogeneous field and double focusing was used for registering a wide spectral range of electrons simultaneously. This was accomplished by mounting a thick-layered photographic plate along the focal line of the spectrometer. Calculations and experimental tests for the location of the focal line were outlined. The horizontal and vertical aberrations were calculated for the entire energy range of the spectrometer. The focusing and energy resolution were investigated experimentally and found to be in good agreement with calculated values. (tr-auth)

30039 NEUTRON POLARIMETER. N. P. Babenko and I. O. Konstantinov. Pribory i Tekhn. Eksperim., No. 2, 29-35(Mar.-Apr. 1964). (In Russian)

A polarimeter for fast neutrons that has a relatively low background level, high stability, and satisfactory efficiency is described. (tr-auth)

30040 CALCULATION OF THE CHARACTERISTICS OF A MULTIROTOR MECHANICAL NEUTRON CHOPPER. V. G. Zolotukhin, L. P. Khamyanov, and A. A. Blyskavka. Pribory i Tekhn. Eksperim., No. 2, 36-9(Mar.-Apr. 1964). (In Russian)

A method for calculating the characteristics of a multirotor mechanical neutron chopper is outlined. The method is general and can be used for calculations on complex chopper systems. The calculations for a three-rotor chopper are presented. Satisfactory agreement with experiment was obtained. (tr-auth)

30041 HYDRODYNAMICS OF A BUBBLE CHAMBER. Yu. A. Budagov, V. P. Dzhelepov, V. G. Ivanov, Yu. F. Lomakin, V. B. Flyagin, and P. V. Shlyapnikov (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekhn. Eksperim., No. 2, 46-50(Mar.-Apr. 1964). (In Russian)

A process for measuring the pressure of liquids in a bubble chamber is described from the hydrodynamic point of view. Expressions giving the relation between the measuring process, the chamber geometry, and physical properties of the liquid are presented. Hydrogasdynamic calculations for the design parameters of the chamber are also given. (tr-auth)

30042 INVESTIGATION OF SPARK CHAMBERS HAVING LARGE MEMORY. G. S. Akopyan, M. I. Daion, V. M. Knyazev, and I. N. Solodnikov (Inst. of Physics, Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 2, 50-7(Mar.-Apr. 1964). (In Russian)

Data on the accuracy of determining particle trajectories in spark chambers filled with air and with mixtures of air, argon, and alcohol vapors are presented. The chamber has high-voltage pulses with delay times of 2 and 30 μsec and a sweeping field of ~100 v/cm. The high-transmission telescope of the chamber is also discussed. (tr-auth)

30043 PRECISION OF THE SEQUENCE OF SPARKS ALONG PARTICLE TRAJECTORIES IN SPARK CHAMBERS. V. N. Bolotov, M. I. Daion, M. I. Devishev, L. F. Klimanova, B. I. Luchkov, and A. P. Shmeleva (Inst. of Physics, Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 2, 57-61(Mar.-Apr. 1964). (In Russian)

Two spark chambers were used to measure the magnitude of the displacement and the angle of deflection of sparks relative to the particle trajectories in spark chambers. Results are presented for spark chambers with an interelectrode spacing of 20 cm. Methods for detecting high-energy cosmic particles (500-600 Bev/c) are also discussed. (tr-auth)

30044 SPURIOUS SCATTERING IN NUCLEAR EMULSIONS PROCESSED WITH ULTRASONICS. A. B. Akopova. Pribory i Tekhn. Eksperim., No. 2, 64-5(Mar.-Apr. 1964). (In Russian)

The relation between the amount of spurious scattering and processing conditions in nuclear emulsions was investigated. The emulsion NIKFI-R of 40 μ thickness was sub-

jected to ultrasonic vibrations of 1.2 and 2.2 Mc. Multiple scattering in layers bombarded by 1.7 Bev protons was measured. The total length of the tracks was greater than 1.5 m. A noticeable decrease in the amount of spurious scattering was obtained in emulsions processed by means of ultrasonics as compared to regular processing methods. (tr-auth)

30045 PHOTOGRAPHIC DEVELOPMENT OF NUCLEAR EMULSIONS WITH ULTRASONIC VIBRATIONS. A. B. Akopova, Kh. B. Pachadzhyan, and L. V. Melkumova. Pribory i Tekhn. Eksperim., No. 2, 66-8(Mar.-Apr. 1964). (In Russian)

The nuclear emulsion NIKFI-R of thickness 400 ± 50 μ was processed using ultrasonic vibrations of 1.1 Mc. It is shown that the total processing time was reduced five fold, the sensitivity was improved, and the amount of distortion was significantly decreased. (tr-auth)

30046 SIMPLE SCHEMATIC OF A COUNTING SYSTEM FOR LOW-ENERGY MULTICHANNEL ANALYZERS. G. D. Alkhazov, A. A. Vorobev, V. A. Korolev, and D. M. Seliverstov (Inst. of Physics and Tech., Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 2, 69-71(Mar.-Apr. 1964). (In Russian)

A schematic diagram and the principles of operation of a counting system for a multichannel pulse analyzer are presented. (C.E.S.)

30047 MEASUREMENT OF THE ENERGY RESOLUTION OF IR-1. G. A. Kibalchich, Yu. A. Grinchenko, and V. A. Sulyga (All-Union Instrument Research Inst. for Monocrystals, USSR). Pribory i Tekhn. Eksperim., No. 2, 76-8(Mar.-Apr. 1964). (In Russian)

A device for measuring the energy resolution of NaI(Tl) scintillating monocrystals is described. A compensation method is used in the apparatus that guarantees precision no worse than that of an amplitude analyzer. The measuring range of the energy resolution is 4–16%, and the duration of the process is about equal to the rise time of a photomultiplier tube. (tr-auth)

30048 HIGH-VOLTAGE PULSE GENERATOR FOR SPARK CHAMBERS. N. A. Burgov, Yu. T. Kiselev, and V. I. Ushakov. Pribory i Tekhn. Eksperim., No. 2, 104-7 (Mar.-Apr. 1964). (In Russian)

The design of a high-voltage pulse generator for spark chambers with capacitances from 5 to 8 nF is presented. The generator has a delay time that is small compared to the time of flight of particles across the chamber (150–300 msec). (tr-auth)

30049 APPLICATION OF GAS SCINTILLATOR FOR MEASURING SHORT PULSES OF X RADIATION. V. A. Perepelka. Pribory i Tekhn. Eksperim., No. 2, 116-19 (Mar.-Apr. 1964). (In Russian)

The possibility of using gas scintillators for detecting intense bursts of x radiation was investigated. The absolute yield of x-ray tubes with anodes of tungsten, iron, and carbon was measured. The experimental results permit the determination of the luminescence efficiency for x-ray absorption. For the short wavelength region at 80, 54, and 27 kv, the conversion coefficients were 0.16, 0.1, and 0.02, respectively. (tr-auth)

30050 PLASTIC SCINTILLATORS CONTAINING TIN. A. V. Chernobai and L. N. Kolesnikov (All-Union Instrument Research Inst., USSR). Pribory i Tekhn. Eksperim., No. 2, 120-1(Mar.-Apr. 1964). (In Russian)

A method for preparing plastic scintillators containing tin for gamma dosimetry is described. The detector is composed of polystyrene with luminescent impurities of terphenyl (2%) and POPOP (0.06%) and contains 2.5% tetraphenyltin. The detector has a luminescence efficiency of 0.8 with respect to conventional polystyrene scintillators. (tr-auth)

30051 APPLICATION OF THE METHOD OF A PAIR OF LIGHT PULSES FOR INVESTIGATING THE TIME CHARACTERISTICS OF PHOTOMULTIPLIERS. V. N. Lebedev. Pribory i Tekhn. Eksperim., No. 2, 133-5 (Mar.-Apr. 1964). (In Russian)

The method and apparatus for determining the amplification coefficient of photomultiplier tubes by means of a pair of light pulses are described. The device has a pulsed light source and uses a direct and mirror-reflected beam. The time interval between the pair of light pulses is in the nsec region. (tr-auth)

30052 EFFICIENCY OF ELLIPTICAL CYLINDERS AS LIGHT SYSTEMS OF QUANTUM GENERATORS. Yu. A. Ananev (State Inst. of Optics, USSR). Pribory i Tekhn. Eksperim., No. 2, 135-7(Mar.-Apr. 1964). (In Russian)

A simple approximate method for calculating the efficiency of elliptical cylinders as light systems for quantum generators is outlined. (tr-auth)

30053 CEMENTED SPARK CHAMBERS. Yu. T. Kiselev and V. I. Ushakov. Pribory i Tekhn. Eksperim., No. 2, 163-4(Mar.-Apr. 1964). (In Russian)

The construction of a spark chamber is described. The individual sections of the chamber consist of a plexiglass frame cemented between two metallic electrodes with an evacuation tube. The adhesives used in the construction are discussed. The performance characteristics of the spark chamber are briefly outlined. (C.E.S.)

30054 HIGH-PRESSURE GAS SCINTILLATION COUNTER. N. P. Babenko, I. O. Konstantinov, and Yu. A. Nemilov. Pribory i Tekhn. Eksperim., No. 2, 164-6(Mar.-Apr. 1964). (In Russian)

The design of a high-pressure gas scintillation detector that can be used for determining the polarization of fast neutrons from nuclear reactions is presented. The counter is filled with ^{4}He and Xe (5–7% Xe) at a pressure of ~100 atm. (C.E.S.)

30055 MEASUREMENT OF THE DEAD TIME OF DETECTORS BY THE PULSED POWER SUPPLY METHOD. G. Grigorov and Zh. Papadopulov (Univ. of Sofia). Pribory i Tekhn. Eksperim., No. 2, 168-9(Mar.-Apr. 1964). (In Russian)

A method for determining the dead time of a radiation detector based on the application of a pulsed power supply for the detector is outlined. A constant voltage and a pulsed voltage of known frequency and amplitude are supplied to the detector. The dead time can be determined as a function of the initial counting rate of the detector. An illustration of the method is presented. (C.E.S.)

30056 YIELD OF THE FRICKE DOSIMETER TO 14.6 Mev NEUTRONS. Robert C. Axtmann and Joseph A. Licari (Princeton Univ., N. J.). Radiation Res., 22: 511-18(July 1964).

A measurement of the yield of the aerated ferrous sulfate–sulfuric acid (Fricke) dosimeter for 14.6-Mev neutrons gave a value of $G(Fe^{3+}) = 11.5 \pm 1.8$. The determination combined an analysis of the energy deposited by scattering and charged particle reactions with a determination of the neutron flux by two independent means, a

long counter method and an activation technique. The result was in reasonable agreement with a prediction of 10 for $G(Fe^{3+})$ based on measured yields of the dosimeter to irradiations by monoenergetic charged particles. (auth)

30057 CONSTRUCTION OF 2π FLOW PROPORTIONAL COUNTER FOR COUNTING ALPHA EMISSION AT LOW LEVELS. A. Moreno y Moreno, C. Archundia, A. Nava, D. B. de Garza (Universidad Nacional, Mexico (City)). Rev. Mex. Fis., 13: 39-53(1964). (In Spanish)

In order to measure very low levels of uranium in air, vegetable oil products, and human urine, a $2-\pi$ gas-flow proportional counter was built. A minimum counting rate of 2 dpm was attained. The slope of the plateau in the counting rate curve for α particles, was found to be 5% in 100 volts. (auth)

30058 $^3He-Ne-CH_4$ MIXTURES IN A PROPORTIONAL COUNTER FOR THERMAL NEUTRONS. Victor E. Krohn, Jr. (Argonne National Lab., Ill.). Rev. Sci. Instr., 35: 853-4(July 1964).

Some mixtures of ^3He, neon, and methane were investigated and found to have advantages as fillings for proportional counters to detect thermal neutrons. Recipes which were satisfactory in a counter with a 3.5-in. diam include 15.7 psi of ^3He + 17 psi of neon + 14 psi of methane and 1.0 psi of ^3He + 25 psi of neon + 8 psi of methane. (auth)

30059 50-NANOSECOND PRINTED CIRCUIT LINEAR GATE USING TRANSISTORS. Arpad Barna (Stanford Univ., Calif.) and J. Howard Marshall. Rev. Sci. Instr., 35: 881-5(July 1964). (SLAC-PUB-22)

A 50-nsec linear gate with primary use in high energy physics experiments is described. The gate has a pedestal stability of 0.2% of the maximum output pulse height and a feedthrough of less than 0.2% over a pulse-height range of 100 to 1. Design considerations, construction details, and performance are discussed. (auth)

30060 PROTOTYPE OF A PORTABLE MICROCALORIMETER FOR MEASUREMENT OF ABSORBED DOSE. E. R. Schleiger and N. Goldstein (Naval Radiological Defense Lab., San Francisco). Rev. Sci. Instr., 35: 890-4 (July 1964).

A prototype of a compact, portable microcalorimeter was built which measures ionizing radiation dose rates as low as 3 rads/min measured in aluminum. The absorber and temperature sensing system are conventional but the temperature-controlled bath which usually surrounds a vacuum chamber in such microcalorimeters was replaced by an aluminum isothermal shield bolted to the bottom surface of a copper reservoir containing liquid nitrogen. Both the shield and the reservoir are contained in a vacuum chamber. Calibration of the absorber is accomplished by observing the response of an imbedded thermistor when the calorimeter is placed in a gamma-ray field of known exposure level provided by a 200-Ci ^{60}Co source. (auth)

30061 ON THE AVALANCHE BREEDING OF GEIGER DISCHARGE IN HALOGEN-QUENCHED G. M. COUNTERS. Juichi Akutsu. Sci. Papers Inst. Phys. Chem. Res. (Tokyo), 57: 155-68(Dec. 1963).

A mechanism of the propagation of Geiger discharge along the anode wire was studied theoretically and the results are compared with the experimental results obtained by van Zoonen. The results obtained elucidate that successive avalanches in argon-bromine counters are mainly due to the photo-electrons produced in the gas and that an insensitive volume for counting in the halogen-quenched G.M. counter may exist depending on the counter voltage, counter dimension and counter filling. Some experimental results showing the characteristic behaviors for the halogen-quenched counters in comparison with the organic gas-quenched counters are also included. (auth)

30062 FINITE SOLID ANGLE CORRECTIONS. M. J. L. Yates (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). p.453-66 of "Perturbed Angular Correlations." Amsterdam, North-Holland Publishing Co., 1964.

An expression for correcting angular correlations for the smearing out produced by the finite size of the detector is derived for the simplified case of a cylindrical detector. The results of more exact calculations, by a Monte Carlo program, of correction factors for crystals of various sizes are presented. (D.C.W.)

30063 A MONTE CARLO CALCULATION OF THE RESPONSE OF GAMMA-RAY SCINTILLATION COUNTERS. Clayton D. Zerby (Oak Ridge National Lab., Tenn.). p.89-134 of "Methods in Computational Physics. Vol. I." New York, Academic Press, 1963.

A calculation of the response of gamma scintillation counters is described in which Monte Carlo methods are used, while analog procedures are not used for the complete problem. Results are in good agreement with experimental results for a counter using a 3×3 in. NaI(Tl) detector. (D.C.W.)

30064 KHIMICHESKAYA DOZIMETRIYA IONIZIRUYUSHCHIKH IZLUCHENII. (Chemical Dosimetry of Ionizing Radiation). A. M. Kabakchi, Ya. I. Lavrentovich, and V. V. Pen'kovskii. Kiev, Izdatel'stvo Akademii Nauk Ukrainskoi SSR, 1963. 155p.

A survey is made of theoretical and experimental material collected for the last year in the sphere of chemical dosimetry. The basic importance is emphasized of the use of chemical dosimetry methods for the solution of problems that are difficult or impossible to solve using other methods (the measurement of absorbed dose in joules per kilogram, separate dose determinations of different types of radiation simultaneously affecting the medium, measurement of large doses, etc.). The technique for determination of dose quantity by chemical methods is considered in detail. The book is intended for a wide circle of specialists occupied in the measurement of absorbed energy of various sorts of radiation. It may be recommended for PhD candidates and students who specialize in radiation chemistry, radiobiology, or radiation physics. (tr-auth)

30065 MNOGOKANAL'NYE ANALIZATORY YADERNOI FIZIKI. (Multichannel Analyzers in Nuclear Physics). L. A. Matalin, S. I. Chubarov, and A. A. Ivanov. Moscow, Atomizdat, 1964. 230p.

An attempt is made to systematize the basic principles of construction of multichannel amplitude and time analyzers and also to discuss more expedient methods of building such systems, in order to help engineers and experimental physicists in the choice of optimal solutions for analyzer construction and for experiment preparation and execution. Relations between energy and pulse amplitude for various detector types, amplitude analysis of pulsed sources, low- and high-energy neutron spectrometry with time analyzers, and multiparameter analysis are considered. (M.J.T.)

30066 THE APOLLO SPACE RADIATION WARNING SYSTEM. Benny R. Baker and Peter W. Higgins (Manned Spacecraft Center, Houston, Tex.). p.489-96 of "Institute of Environmental Sciences, 1964 Proceedings." Mt. Prospect, Ill., Institute of Environmental Sciences, 1964.

The proposed system comprises a network of solar optical and radio telescopes to follow solar activity in order to provide Apollo crews with warning of solar proton events. The system, its operation and location, and possible courses of action in event of a warning are briefly described. (D.C.W.)

30067 STUDIES OF A LARGE GAP SPARK CHAMBER. William R. Dawes, Jr. (Univ. of Arizona, Tucson). 34p. (CONF-531-5)

From American Physical Society 1964 Southwestern Meeting, Tucson, Ariz., Feb. 1964.

The spatial resolution, efficiency, and threshold operating conditions of a large-gap spark chamber (24 × 24 × 8 inches), as a function of its operational parameters, were investigated in order to determine its optimum operating conditions. A multigap spark chamber was placed beneath the large-gap chamber and both were triggered on the same incident cosmic ray particle. The trajectory of the incident particle was defined by the multigap chamber and expressed as a space angle, measured from the normal to the plates. The performance of the large gap chamber was evaluated by comparing the space angles of a particle as determined by both chambers. For helium gas at an absolute pressure of 520 torr an efficiency of 75% was observed for track inclinations in the range 0 to 24°, whose deviation from the actual track inclination was 5° or less. Beyond 24°, the efficiency rapidly decreased. The median value for the deviation with the angular range 0 to 24° was 2.4 ± 1.9°. Results for the other operational parameters are discussed. (auth)

30068 LIGHT COLLECTION AND OPTICAL COUPLING IN LONG SCINTILLATOR RODS. D. W. Blincow and J. R. Webster (Giannini Controls Corp., Duarte, Calif.). 20p. (CONF-182-26)

From 9th Scintillation and Semiconductor Counter Symposium, Washington, D. C., Feb. 1964.

Research and development work is described on a scintillation detection system that will be used in a Zero "G" propellant gaging system for the Apollo mission. The system uses gamma emitters and a number of plastic scintillator rods, all optically coupled to one phototube, that fans out over the tank surface. Because the rods must act both as gamma detectors and as light guides, it was necessary to study the attenuation of light pulses in long, thin rods of different diameter, length, and material. An equation was derived for the light intensity at one end of a rod resulting from scintillations occurring anywhere along its length, and the coefficients were empirically determined. The laboratory techniques used to couple scintillators and phototubes are generally inadequate where a wide range of environments are encountered. This is especially true for plastic scintillators where some relative motion of the plastic and the phototube and faceplate must be allowed to accommodate their different temperature coefficients of expansion. A series of tests of light attenuation, as a function of light wavelength and coupler thickness, was made for several solid, semi-solid, and viscous liquid couplers. (auth)

30069 UNIFORM AND STABLE dE/dx/P-N JUNCTION PARTICLE DETECTORS. T. C. Madden and W. M. Gibson (Bell Telephone Labs., Inc., Murray Hill, N. J.). 31p. (CONF-182-27)

From 9th Scintillation and Semiconductor Counter Symposium, Washington, D. C., Feb. 1964.

Solid-state dE/dx · E particle identification systems require thin dE/dx detectors having a high degree of thickness uniformity. In addition, reproducible and straightforward fabrication techniques, long term stability, and ruggedness are desired for the routine use of such devices. The use of oxide surface passivation, a planar-etching procedure, and an improved back contact have made possible the reproducible construction of thin, uniform, and stable diffused-junction particle detectors that meet these requirements. The response of these detectors to both penetrating and nonpenetrating particles, and the effects of particle channeling through the crystal lattice, are discussed. (auth)

ISOTOPE TECHNOLOGY

General

30070 A RECALIBRATION OF THE NATIONAL BUREAU OF STANDARDS TRITIATED WATER STANDARDS BY GAS COUNTING. W. B. Mann, R. W. Medlock, and O. Yura (National Bureau of Standards, Washington, D. C.). Intern. J. Appl. Radiation Isotopes, 15: 351-61(June 1964).

The National Bureau of Standards ^{3}H standards were prepared in the winter of 1954–55 using microcalorimetric measurements. They were re-calibrated by means of the National Bureau of Standards length-compensated internal gas counters. The new value for their activity was 1.96% lower than that previously measured, but this difference also involves uncertainties in the half life and the average beta energy for ^{3}H. A value for the ratio of the combined evaporation and reaction rates with zinc, for HTO and H_2O, equal to 0.92 was obtained. (auth)

30071 DETECTION OF FINGERPRINTS BY AUTORADIOGRAPHY. (INITIAL REPORT). E. Lelental and A. Szuchnik (Inst. of Nuclear Research Warsaw). Intern. J. Appl. Radiation Isotopes, 15: 373-5(June 1964). (Translated from Probl. Kriminal. No. 42, (1963).

An autoradiographic method of detecting prints of papillary lines is described. U and ^{110}Ag were used as sources of radioactivity. The isotope was applied to the prints of papillary lines by sprinkling UO_2 or AgCl labeled with ^{110}Ag and also by depositing ^{110}Ag from aqueous solution of $^{110}AgNO_3$ directly on the prints or on the prints previously exposed to iodine vapor. The subjects of these experiments included both fresh prints and prints several days old made on paper, glass, and textiles. The usefulness for dactyloscopic purposes of the labeled compounds was established. (auth)

30072 A NEW METHOD FOR PREPARING RADIOACTIVE SOURCES. E. Fuschini, C. Maroni, C. Porceddu, and P. Veronesi (Università, Bologna and Istituto Nazionale di Fisica Nucleare, Bologna). Nucl. Instr. Methods, 26: 301-4(Mar. 1964).

A new technique for preparing thin and uniform radioactive sources is described. The method is based on the spraying of a solution, containing the radioactive nuclide, by using a mechanical nebulizer and on the use of a high electric field applied between the nozzle of the nebulizer and the collecting surface. This process is very simple and can be widely used. The yield of the deposition ranges between 50 and 70% but can even be higher than this last value. The deposition results are uniform and compact. (auth)

30073 MOLECULAR PLATING. III. THE RAPID PREPARATION OF RADIOACTIVE REFERENCE SAMPLES. W. Parker, H. Bildstein, and N. Getoff (Österreichische Studiengesellschaft für Atomenergie GmbH, Seibersdorf, Austria). Nucl. Instr. Methods, 26: 314-16 (Mar. 1964).

The rapid electrodeposition of those nuclides commonly employed as reference samples for the calibration of nuclear particle detection equipment is described. Those nuclides dealt with here are cesium-137, cobalt-60, calcium-45, iron-55, zinc-65, and strontium-90. All of the nuclides can be prepared on any desired, electrically conducting, backing material and due to the excellent adhesion properties of the deposited material require no protective layer or film over the surface. Detailed preparation data are given in the form of tables enabling the preparation of a given nuclide to be carried out under the most favorable conditions. (auth)

Industrial Applications

30074 (TID-20703) BIOCHEMISTRY AND PHYSIOLOGY OF IRRADIATED FRUITS AND VEGETABLES. Annual Progress Report, September 4, 1963–September 3, 1964. Louis M. Massey, Jr. and John B. Bourke (New York. State Agricultural Experiment Station, Geneva). May 31, 1964. Contract AT(30-1)-3274. 66p.

Progress is reported in studies on the changes induced by radiation in fresh fruits and vegetables and the effects of radiation processing on the extension of the storage life of fruits and vegetables under refrigeration and at room temperature. Emphasis is placed on the biochemistry of tissue softening and the effects of radiation on the biochemical processes of metabolism and respiration in fruits and vegetables. Data are presented from studies on the effects of radiation processing on texture, respiratory activity, taste, color, and refrigerated and non-refrigerated storage life of cherries; the effects of radiation processing on the in-storage production of ethylene by apples; and the effects of x radiation on intermediary metabolism in carrot tissues. (C.H.)

30075 HYGIENIC ASPECTS OF RADIATION PRESERVATION OF FOODSTUFFS. R. Keil (Institut für Allgemeine Hygiene, Rostock, Ger.). Arch. Hyg. Bakteriol., 145: 571-85(Dec. 1961). (In German)

The status of the use of ionizing radiation to lengthen the storage life and to sterilize various articles of food is reviewed. (BBB)

30076 "MARKED" MOLECULES: MODERN RESEARCH TOOLS. Jean Sirchis. Euratom Bull., No. 2, 12-17(June 1964).

Preparation and uses of labeled compounds are discussed. Uses in chemistry, biology, and medicine are described. Obstacles to the use of labeled compounds and ways of overcoming them are outlined. Chemical synthesis, biosynthesis, and radiochemical methods for preparing these labeled compounds are described and illustrated. (C.E.S.)

30077 RADIOACTIVE STATIC ELIMINATORS. Denis Taylor. Ind. Electron., 717-19(Nov. 1963).

The design and performance of a radioactive static eliminator is reported. The radioactive static eliminators operate on the same principle as the electrical methods, namely by making the air conducting so that the charge leaks away to earth. One popular source for discharging static is ^{204}Tl. Other radioactive sources used include ^{226}Ra, ^{210}Po, ^{90}Sr, ^{35}S, ^{147}Pm, ^{45}Ca, and ^{3}H. The use of static eliminators also prevents the accumulation of dust on the warp threads in the weaving industry with consequent deterioration of the product. (P.C.H.)

30078 RADIATION PROCESSING OF FOODS: SOME EFFECTS OF GAMMA RADIATION ON THE KEEPING QUALITY OF APPLES. L. M. Massey, Jr., G. F. Parsons, and R. M. Smock (Cornell Univ., Ithaca, N. Y.). J. Agr. Food Chem., 12: 268-73(May-June 1964).

Three varieties of apples were irradiated with ^{60}Co at

various degrees of maturity and evaluated for storage longevity from the standpoint of texture, color, flavor, and susceptibility to storage disorders. The principal immediate effect of irradiation was a softening by doses in excess of 10 krad, and a transient stimulation of oxygen consumption. Neither the percent of alcohol-insoluble solids nor total anhydrogalacturonic acid residues changed appreciably due to irradiation. However, the conversion of insoluble to soluble pectins during storage was markedly retarded by irradiation. (H.M.G.)

30079 ON THE APPLICABILITY OF RADIOACTIVE INDICATOR METHODS FOR DETERMINATION OF THE SURFACE AREA OF SOLID MATERIALS. PART III. L. Imre and J. Nagy (Univ. of Debrecen, Hungary). Kolloid Z., 183: 134-41(June 1962). (In German)

The method which is described depends on the adsorption of ThB^{++}, $^{110}Ag^{+}$, and other ions to the surface of noble metals, such as Pt and Au. (BBB)

30080 IRRADIATION: PRESENT AND FUTURE APPLICATIONS. P. J. Bailey and B. D. Baines (Nuclear Chemical Plant Ltd., London). Nucl. Eng., 9: 213-16 (June 1964).

Insect elimination by release of sterile males is discussed and conditions for successful application of the technique are listed. Using radiation to kill or sterilize insects in infected grains to reduce grain losses is also discussed. Food irradiation to kill fruit flies, to improve storage properties, to complete sterilization, and to eliminate salmonella is described. The designs of typical chemical irradiation plants are described, in which radiation is used to promote chemical reactions. Radioinduced sterilization of surgical products is also discussed. Control and measurement of dose is described. (M.C.G.)

30081 ^{63}Ni β-RAY SOURCE USED ON THICKNESS GAUGE. Teiji Uemura (Osaka Prefecture). Radioisotopes (Tokyo), 13: 205-12(May 1964). (In Japanese)

The accumulation of deposited soot was measured with ^{63}Ni 0.067-Mev β particles using an end-window type G-M tube. The x rays produced from the scattering of β particles and the radiations from active impure atoms in a source influenced the accuracy of the thickness measurement. Those impure atoms were mainly long-lived ^{60}Co and ^{59}Ni. ^{63}Ni is electroplated on copper plates in an industrial plating solution containing $^{63}NiCl_2$. The radiations emitted from these sources are counted through filters of 5.4 mg/cm^2 polyethylene or 540 mg/cm^2 Al foil. Counting rates of β, X-ray, and γ components were obtained. The counting rates of β particles and backgrounds fit the relation $I_\infty(1 - e^{-\mu T})$ with different absorption coefficients, μ, as function of thickness of source, T. The β counting rate saturated at thinner source layers because of higher self-absorption. At thicker layers, the counting rates of background components were more dominant than that of β particles. When a thin source was prepared from the plating solution of low activity and the counting rate of β particles was too low, the accuracy of the gage was bad under the influence of natural background. The suitable thickness (at minimum $\Delta x/x$) for the source for the best accuracy was calculated. It was concluded that the method could be used in measurement of the concentration of soot-dust in a furnace. (auth)

30082 RELEINYE USTROISTVA S ISTOCHNIKAMI YADERNOGO IZLUCHENIYA. (Relay Arrangements with Sources of Nuclear Radiation). A. G. Vasil'ev and K. S. Klempner. Moscow, Gosudarstvennoe Nauchno-Tekhnicheskoe Izdatel'stvo Mashinostroitel'noi Literatury, 1963. 167p.

Relay arrangements with sources of nuclear radiation (radioisotope relays) are described. Examples of their application in radiation detectors and in remote-control processes are given, and the importance of widening the sphere of their use is explained. Methods for the calculation of radioisotope relays are presented in detail, taking into account both statistical errors and systematic errors of the apparatus. (tr-auth)

Separation and Production

Refer also to abstracts 29796 and 30676.

30083 RESULTS IN PRODUCING CLOSED RADIATION SOURCES IN HUNGARY. [PART] II. Gyoergy Cserep and Vilmos Stenger. Energia Atomtech., 16: 188-91(Apr. 1963). (In Hungarian)

30084 CONTRIBUTION TO THE STUDY OF PARTITION FACTORS OF DEUTERIUM BETWEEN AMMONIA AND HYDROGEN. B. Lefrancois and Y. Bourgeois. Genie Chim., 90: 138-49(May 1964). (In French)

Heavy water can be produced by deuterium exchange between ammonia and hydrogen. Effective partition factors for these two substances are defined; and the results of measurements by which the expressions can be evaluated are presented, together with the calculated factors. (D.C.W.)

30085 PRODUCTION OF Cu-64 SAMPLES OF HIGH SPECIFIC ACTIVITY IN THE HOT CELL OF FRM. N. Mann (Universität, Erlangen, Ger.) and H. Staerk. Kerntechnik, 6: 237-9(June 1964). (In German)

The production of high specific ^{64}Cu activity used as a source in polarized-electron experiments is described. The activity was produced in curie levels by Szilard-Chalmers reaction in Cu-phthalocyanine. The chemical separation and purification of the activity was performed automatically by special apparatus in the hot cell of the FRM. (auth)

MATHEMATICS AND COMPUTERS

30086 (AEEW-M-444) A MERCURY PROGRAMME FOR TRANSFORMING DATA ON THE ANGULAR DISTRIBUTION OF ELASTICALLY SCATTERED NEUTRONS TO ONE STANDARD FORM. D. C. King (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Apr. 1964. 10p.

Data on the angular distribution of elastically scattered neutrons are reported in one or another of a variety of different forms. The Mercury autocode program 5675 transforms the data into a tabular representation of the form [cosθ, p(cosθ)] where p(cosθ) is the normalized probability distribution and θ is the scattering angle in the center-of-mass frame of reference. Output on cards punched in the format of U.K.A.E.A. nuclear data library is optional. (auth)

30087 (AERE-M-1411) CONTENT-ADDRESSABLE STORES. E. H. Cooke-Yarborough (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). June 1964. 3p.

The use of content-addressable storage in multidimensional pulse analysis to save storage space is discussed. (R.E.U.)

30088 (AEEW-R-323) ERIC 2—A FORTRAN PROGRAM TO CALCULATE RESONANCE INTEGRALS AND FROM THEM EFFECTIVE CAPTURE AND FISSION CROSS-SECTIONS. Helen M. Sumner (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Apr. 1964. 40p.

The IBM 7090 Fortran program ERIC 2 is described. The program is used to compute effective resonance integrals and cross sections for both fissile and nonfissile nuclides, and for resolved and unresolved resonances. The "intermediate-resonance" theory of Goldstein and Cohen is incorporated, and in the region of unresolved resonances the partial widths are averaged over their respective distribution functions. The program is suitable for either thermal or fast reactor calculations. (auth)

30089 (AERE-R-4599(Pt.I)) ATLAS FORTRAN MANUAL. PART I. E. J. York (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Apr. 1964. 37p.

The manual (Pts. I and II) describes one operating system (HARTRAN) for the I.C.T. Atlas computer. Part I describes the FORTRAN language, and Part II describes the use of the HARTRAN system to obtain compilation and execution of a FORTRAN program. Part I is presented. (R.E.U.)

30090 (CERN-64-32) A FORTRAN PROGRAMME AND SOME NUMERICAL TEST RESULTS FOR INTEGRATION OVER A TRIANGLE. K. S. Koelbig (European Organization for Nuclear Research, Geneva). June 25, 1964. 47p.

A Fortran II program was written for IBM 7090 and some test integrations are presented. A general subdivision algorithm used in the program is described. The program may be extended for polygons. (R.E.U.)

30091 (CLM-R-36) NUMERICAL METHODS OF SOLVING THE TRANSPORT EQUATION. A. G. Hearn (United Kingdom Atomic Energy Authority. Research Group. Culham Lab., Culham, Abingdon, Berks, England). Mar. 1964. 26p.

Some numerical methods are described for solving the transport equation when it is applied to the radiative transfer of doppler-broadened resonance lines emitted by a two-level atom in a uniform plane-parallel plasma and where the solution is independent of time. These methods include a solution where the source function is assumed to vary in space, frequency, and direction, which is equivalent to a neutron multigroup calculation with anisotropic scattering. The methods are particularly suitable for nearly perfect scattering. (auth)

30092 (EUR-1632.f) MATRICES TOTALEMENT UNIMODULAIRES ET PROBLEMES COMBINATOIRES. (Totally Unimodular Matrices and Combinatorial Problems). P. Camion (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy and European Atomic Energy Community. European Scientific Data Processing Center, Ispra, Italy). 1964. 85p.

In the theory of linear economical models, numerous problems have as models linear programs where solutions in integers are required. Moreover, R. Fortet showed that combinatorial problems can be formalized in terms of linear inequalities with integer solutions. I. Heller, A. J. Hoffman, and J. Kruskal have characterized classes of interesting matrices for these problems. The subclass, which is the intersection of the classes defined by those authors, is the class of the totally unimodular matrices or E-matrices. This class justifies the maximum of interest. One of these interesting subclasses is the one of the cyclomatic or cocyclomatic matrices of graphs. It is shown that two subclasses of E-matrices defined by A. J. Hoffman belong to the class of cyclomatic matrices. It is shown that a class of matrices defined by Tutte coincides with the class of linear transforms of E-matrices. The E-matrices are characterized by utilizing concepts of the theory of graphs and the homomorphisms of the ring of integers on the quotient field modulo 2. In particular the known fact that the cyclomatic and cocyclomatic matrices of graphs are E-matrices results immediately from this characterization. A criterion is given in order that the polyhedron $\{x \mid Ax = O;\ a \leq x \leq b;\ [x_i]_{mod_i} = O\}$ (a and b, vectors with integer coordinates, A being an E-matrix) be nonempty. This criterion is given by a more general theorem on Abelian groups. This theorem generalizes the theorem of A. J. Hoffman on the existence of a flow in a network and another theorem by the same author given as the most general of the Hall-type. Various theorems on flows and tensions, cycles and cocycles of a graph are generalized by this theorem. A characterization of cyclomatic and cocyclomatic matrices of a graph, which completes the one of W. T. Tutte for the homomorphisms modulo 2 of these matrices is given. A characterization of the E-matrices modulo 2 is also given. (auth)

30093 (EUR-1824.i) UN METODO PER LA SELEZIONE DEI "TESTS." (Method for the Choice of Tests). W. De Ambrogio (Universita Commerciale Luigi Bocconi, Milan). 1964. Contract 015-61-5CETI. 30p.

The decision on the suitability of carrying out a certain test entails the comparison of the cost of the test and amount of information that it furnishes. The principal factor analysis is utilized as a point of departure for the de-

termination of the quantity of information furnished by each test. In order to do this (1) the factors that give non-significant results are eliminated; (2) one proceeds iteratively with the estimate of communalities; and (3) one arrives at the relations $Z_j = a_{j1}F_1 + a_{j2}F_2 + \ldots + a_{jm}F_m$ ($j = 1,2, \ldots, n$) and in turn $F_s = b_{s1}Z_1 + b_{s2}Z_2 + \ldots + b_{sn}Z_n$ ($s = 1,2, \ldots, m$). The product $(a_{js}b_{sj})$ measures the importance of the variable Z_j as a "determiner" of F_s. It is proposed to extend the analysis of all the factors considered taking account of the total contribution of a factor to the variance of all the variables. The expression

$$Q_j = \sum_{s=1}^{m} a_{js}b_{sj}\frac{A_s}{n}$$

(where A_s is the total contribution of the factor F_s) is a measure of the quantity of information furnished by a certain variable. (auth)

30094 (EUR-1839.e) HET-B2: A HETEROGENEOUS METHOD FOR REACTOR CALCULATIONS. S. Albertoni, G. Blaesser, G. d'Amico, and C. G. Clerici (Milan. Università. Istituto di Fisica Teorica). 1964. 70p.

A mesh-type heterogeneous method for reactor calculations is described. The mathematical model used as well as the numerical procedure employed for the actual calculations are discussed, and a complete listing of the Fortran-code for the IBM 7090 is given. Calculations of the surface matrix of a fuel element in cylindrical geometry, of the flux near a fuel element, and of fluxes within a moderator-filled region are discussed. (auth)

30095 (EURAEC-987) HYTHEST—A MONTE CARLO PROGRAM FOR THE EVALUATION OF THE CORRECTION FACTORS IN A BWR AND PWR CORE. A. Borella, G. Di Cola, and G. Pozzi (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy). 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 035-60-11-RDI. 73p. (EUR-1587.e)

HYTHEST is a Monte Carlo code written in Fortran II language for the IBM 7090. With this code it is possible to study statistically the influence that the random variations of the independent parameters subjected to fabrication tolerances (fuel density and enrichment, geometric dimension) have on the dependent thermal hydraulic variables (temperatures, vapor quality, pressure drop) in a PWR and BWR reactor core. According to the "spot model," a random core is built up, choosing in every region of the core the values of the independent parameters with the aid of a random sampling routine. Next with a detailed thermal hydraulic calculation routine the values of the dependent variables are calculated in this random sampled core. This procedure is repeated according to a Monte Carlo technique, choosing as many random cores as necessary. HYTHEST contains a main program and 11 subroutines, and uses about 24,000 words of data storage and 6,000 words for program storage. (auth)

30096 (LADC-5901) RECENT IMPROVEMENTS IN MADCAP. Mark B. Wells (Los Alamos Scientific Lab., N. Mex.). [1963]. Contract [W-7405-eng-36]. 20p.

MADCAP is a programming language admitting subscripts, superscripts, and certain forms of displayed formulas. This paper discusses recent improvements in the language in three areas: complex display, logical control, and subprogramming. In the area of complex display, the most prominent improvements are a notation for integration and for the binomial coefficients. In the area of logical control the chief new feature is a notation for variably nested looping. The discussion of sub-programming is focused on MADCAP's notation for and use of "procedures." (auth)

30097 (TID-20751) REPORT ON A METHOD FOR MANGIASPAGO CALIBRATION. Technical Report No. 364. G. B. Yodh, M. C. Whatley, and G. R. Charlton (Maryland. Univ., College Park). Apr. 1964. Contract AT(40-1)-2504. 16p.

Descriptions of the mathematical procedure used in obtaining Mangiaspago parameters, a FORTRAN program used to do the minimization, and results of measurements for the University of Maryland Mangiaspago Measuring Machines are presented. Mangiaspago is an image plane device, which measures biradial coordinates of a point. (R.E.U.)

30098 (TID-20794) TECHNICAL PROGRESS REPORT. PART I. HIGH-SPEED COMPUTER PROGRAM. PART II. ILLIAC II SYSTEM PROGRAMMING, MAINTENANCE AND OPERATION. PART III. CIRCUIT RESEARCH PROGRAM. PART IV. IBM 7094-1401 SYSTEM. PART V. GENERAL LABORATORY INFORMATION. (Illinois. Univ., Urbana. Digital Computer Lab.) Apr. 1964. Contract AT(11-1)-415. 60p.

Progress is reported on the high-speed computer program, magnetic drum memory, component testing, operation of ILLIAC II, various circuit research projects, and IBM 7094-1401 system development. The problems solved by the computers are described, and the operation of the computers is summarized. (D.L.C.)

30099 (TID-20795) TECHNICAL PROGRESS REPORT. PART I. HIGH-SPEED COMPUTER PROGRAM. PART II. ILLIAC II SYSTEM PROGRAMMING, MAINTENANCE AND OPERATION. PART III. CIRCUIT RESEARCH PROGRAM. PART IV. IBM 7094-1401 SYSTEM. PART V. GENERAL LABORATORY INFORMATION. (Illinois. Univ., Urbana. Digital Computer Lab.). Mar. 1964. Contract AT(11-1)-415. 56p.

Machine errors and status of the high-speed computer program are discussed. The operation of the ILLIAC II system is summarized. The circuit research includes photocoupled circuits, photomemory, hot electrode diode, and tunnel diode theory. The problems solved by IBM 7094 are described. The operation of the IBM 7094 and 1401 computers is summarized. (D.L.C.)

30100 (UCRL-7444) A FLOW ANALYSIS ALGORITHM. Lee Krider (California. Univ., Livermore. Lawrence Radiation Lab.). Aug. 1, 1963. Contract W-7405-eng-48. 16p.

An algebraic representation of the flow of a computer program is described. An algorithm is presented for manipulating this representation into a form from which a flow chart can be drawn. A procedure for forming the algebraic representation from a compiler source code is also described. (auth)

30101 THEORETICAL COMPUTATIONS BASED ON PRACTICAL UNITS. E. Beynam. Atomkernenergie, 9: 201-7(May-June 1964). (In German)

Description of the time-independent technique for reformulating various physical theories and mathematical methods in order to gain better insight into natural phenomena was continued from previous studies. Emphasis was placed on dimensional aspects of the expressions used rather than on numerical results of the experiments performed. An attempt was made for an overall simplification of the general picture of nature. After a preliminary review and survey-

ing remarks pertaining to time and measurements, specific examples from several branches of physics are given and references are cited. (auth)

30102 BERGMAN'S INTEGRAL OPERATOR METHOD IN GENERALIZED AXIALLY SYMMETRIC POTENTIAL THEORY. R. P. Gilbert (Naval Ordnance Lab., White Oak, Md. and Univ. of Maryland, College Park). J. Math. Phys. (N. Y.), 5: 983-97(July 1964).

A study is made of properties of solutions to the equation of generalized axially symmetric potentials. These potentials play an important role in many aspects of mathematical physics, in particular in understanding compressible flow in the transonic region. The ideas basic to the investigation are contained in the integral operator method of Bergman. This method allows certain properties of analytic functions to be transplanted to the solutions of linear partial differential equations. Results are obtained concerning singularities, residues, bounds, and growth of entire solutions, which are analogous to those found in classical function theory. (auth)

30103 NOTE ON VOLTAGE SENSITIVE TUNNEL DIODE DISCRIMINATORS. A. Adin and B. Sabbah (Israel Atomic Energy Commission, Tel-Aviv). Nucl. Instr. Methods, 26: 355(Mar. 1964).

A low-hysteresis, voltage-sensitive tunnel diode discriminator for use with an analog-to-digital converter is described. (C.E.S.)

30104 ESTIMATING CONVERGENCE RATES OF VARIATIONAL CALCULATIONS. Charles Schwartz (Univ. of California, Berkeley). p.241-66 of "Methods in Computational Physics. Vol. II." New York, Academic Press, 1963.

An analytical procedure for improving the accuracy of estimating convergence rates of variational calculations is presented. Model expansion problems of integrated least-square fitting of functions serve as the basis for the analysis of the real problem of variational approximations to solutions of Schrödinger's equation. Examples from the study of two-electron atoms are presented. (L.B.S.)

METALS, CERAMICS, AND OTHER MATERIALS

General

Refer also to abstracts 30953 and 30991.

30105 (AD-429028) DEVELOPMENT OF PROTECTIVE COATING FOR TANTALUM-BASE ALLOYS. Quarterly Progress Report No. 2, September 1, 1963–November 31, 1963. B. Ohnysty and A. R. Stetson (Solar Aircraft Co., San Diego, Calif.). Dec. 12, 1963. Contract AF33 (657)-11259. 58p. (RDR-1360-2)

Pack cementation studies were conducted on 90Ta-10W alloy with pure silicon and silicon plus tungsten, molybdenum, chromium, vanadium, boron, manganese, and aluminum. Oxidation test results at 2700°F indicated that the vanadium–chromium, titanium–chromium, and titanium-modified silicide provided the longest oxidation lives, i.e., three to five hours. The straight silicide and tungsten, molybdenum, and vanadium modified silicide gave lives up to three hours. Chromium modified silicide provided the shortest life. Measurement of the thermal expansivities and oxygen diffusion rates through high hafnia oxide compositions continued. Modification of hafnia with zirconia and/or yttria appeared to be capable of producing a close expansion match with 90Ta-10W alloy. (auth)

30106 (AD-430773) COLUMBIUM ALLOY SHEET ROLLING PROGRAM. Interim Report No. 5, November 7, 1963–January 6, 1964. H. L. Kohn and R. M. Curcio (Fansteel Metallurgical Corp., North Chicago, Ill.). Jan. 7, 1964. Contract NOw 63-0231-c. 18p.

Testing of FS-85 (Nb-27Ta-10W-1Zr) 0.060-in.-thick x 18-in.-wide sheet was completed. Further processing of B-66 (Nb–5V–5Mo–1Zr) to 0.060-in.-thick sheet is described. (auth)

30107 (AERE-R-4594) THE MAGNESIUM–ZIRCONIUM SYSTEM—DIFFUSION AND CONSTITUTIONAL STUDIES. E. N. Hodkin, I. Macphail, P. M. Thomas, and D. M. Poole (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). 1964. 22p.

The bonding of zirconium to magnesium by short-time heating under pressure has been studied and the dependence on surface treatment and on zirconium purity has been demonstrated but not explored. Diffusion anneals of bonded couples have shown the existence of two zones—one of columnar crystals and a roughly constant zirconium concentration ~10 wt %, and the other a region, showing fine precipitation, of solid solution of zirconium in magnesium (the maximum solubility measured by microprobe analysis being 3½ to 4 wt %). No evidence has been found of a third zone, expected from American work, in which zirconium is severely embrittled by magnesium penetration. Growth rates of the zones are reported. (auth)

30108 (BMI-X-10083) DEVELOPMENT OF URANIUM MONONITRIDE. Quarterly Progress Report, January–March 1964. Donald L. Keller (Battelle Memorial Inst., Columbus, Ohio). Apr. 1, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract W-7405-eng-92. 12p. (EURAEC-1033)

Methods of fabricating uranium mononitride and uranium nitride–titanium nitride systems by both powder-metallurgy and melting and casting techniques are developed and discussed. These materials are characterized with respect to density, grain size, homogeneity, and chemical purity. Chemical compatibility of uranium nitrides with water, carbon dioxide, water-saturated air, and nickel is evaluated at 100 to 900°C. The effects on uranium mononitride of irradiations to peak burnups are determined. Decomposition measurements of uranium mononitride are reported down to 10^{-7} atm. (N.W.R.)

30109 (CONF-524-9) THEORY OF LIQUID DIFFUSION PHENOMENA. H. A. Walls and W. R. Upthegrove (Oklahoma. Univ., Norman). [196?]. Contract AT(40-1)-1976. 37p.

From American Institute of Mining, Metallurgical and Petroleum Engineers Annual Meeting, New York, Feb. 1964.

The available theoretical models for liquid diffusion are critically reviewed. A new theoretical model is developed in which the self-diffusion coefficient is correlated to (1) a geometrical parameter which is defined as the ratio of the diffusing particle radius to the interparticle spacing, (2) a configurational parameter dependent only upon the coordination number of the liquid, and (3) an activation energy which is identical to that for viscosity. This new model accurately predicts the self-diffusion behavior in ten liquid metals for which data are available. It is shown that the geometrical and configurational parameters can be assigned constant values for the class of liquids comprising the liquid metals. Further, it is shown that even with a temperature-independent activation energy the new model predicts the curvature observed in data when the logarithm of the diffusion coefficient is plotted against the reciprocal absolute temperature. (auth)

30110 (EUR-86.d) UNTERSUCHUNG VON LEGIERUNGEN DES ZIRKONIUMS MIT NIOB UND ZINN IM HINBLICK AUF DEREN VERWENDUNG ALS HULIMATERIAL IN WASSERGEKUHLTEN KERNREAKTOREN. (Investigation of Zr Alloys with Nb and Sn: Their Use as Cladding Materials in Water-Cooled Reactors). W. Jung-Koenig, H. Richter, J. C. Tverberg, P. Wincierz, and U. Zwicker (Metallgesellschaft A. G., Frankfurt am Main). 1963. 100p.

The zirconium alloy ZrNb3Sn1, which has been found as promising in respect of its use as cladding material in watercooled nuclear reactors, was tested more intensively. During the corrosion in high temperature water (350°C) and steam (400°C), it has a lower hydrogen uptake than in Zircaloy-2. The optimum temperature for heat treatment due to the results of corrosion tests and mechanical testing is 580 ± 10°C. Cold work has no important influence on the corrosion attack. The alloy ZrNb3Sn1 may be welded by normal welding procedures used for Zircaloy-2, but it is necessary to heat treat the welds to improve their corrosion behavior. A hydrogen content in the alloy ZrNb3Sn1 favors the formation of a martensitic structure with an increase of hardness. A hydrogen content up to 1,000 ppm has no bad influence on the creep strength. Impact tests showed that hydrogen containing and hydrogen free samples of ZrNb3Sn1 are superior to the corresponding samples of Zircaloy-2 especially at low temperatures. It is possible to fabricate seamless tubes of ZrNb3Sn1. The fabrication possibilities are discussed. A fiber texture with $[10\bar{1}0]$ parallel to the tube axis is found in the extruded tubes, while the hexagonal basis normales are lying in the cross section of the tube. During working the fiber texture is transformed into a ring fiber texture. The creep strength

of the tubes is equal to that of rods. The tin content of 1% in the alloy ZrNb3Sn1 is soluble at temperatures from 575 to 750°C. The equilibrium is reached very sluggishly. (auth)

30111 (GEMP-35A) HIGH-TEMPERATURE MATERIALS PROGRAM. Progress Report No. 35, Part A. (General Electric Co. Advanced Technology Services, Cincinnati). May 28, 1964. Contract AT(40-1)-2847. 58p.

Creep and stress-rupture of Re, W, and Mo in H_2 are measured above 1600°C. Radiation effects of fast neutrons on W, W–Re, and A-286 are measured, and the effects of neutrons on the mechanical properties of pressure shells are calculated theoretically. (T.F.H.)

30112 (HW-76304) CERAMICS RESEARCH AND DEVELOPMENT OPERATION. Quarterly Report, October–December 1963. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Contract AT(45-1)-1350. 118p.

Progress is reported for numerous projects in ceramics research, fuel development and testing, and metallurgy of claddings. Abstracts are presented for the three sections. (N.W.R.)

For abstracts of individual sections see: 30113, 30973, and 30974.

30113 (HW-76304(p.2.1-43)) CERAMICS RESEARCH. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Materials used in connection with the process of fabrication of fuel elements were analyzed for halide contents. Desorption of water from PuO_2 and UO_2–1% PuO_2 occurred at a higher temperature than for pure UO_2. Recent analytical results indicated that small quantities of carbon and organic material were picked up during processing of PRTR fuel material. Small capsules loaded with UO_2–PuO_2 PRTR fuel indicate accidentally introduced oil was a possible cause of some cladding ruptures. A metallography facility for examination of alpha-active materials is being installed in the Plutonium Fabrication Pilot Plant. High resolution autoradiographs of irradiated UO_2 were obtained using a stripping film technique. The translucent character of thin sections of single crystal UO_2 makes possible the examination of UO_2 microstructure by optical transmission microscopy. The optical absorption spectra of single crystals of Al_2O_3 and MgO were determined in the spectral range of 0.2 to 15 μ. Variations in thermal diffusivity data for a UO_2 single crystal are attributed to oxidation of the specimen during the heating cycles. An experiment was devised for measuring the work function and emission constant for plutonium compounds using a contact potential difference technique. Apparatus for measuring electrical resistivity and thermal conductivity was used successfully for measuring resistivity above 1500°C, and samples are being prepared for thermal conductivity measurements. UO_2–50 vol % W cermets were heat treated at 1900 to 2000°C and 2500 to 2600°C for various times in different types of atmospheres. UO_2 loss occurs much more rapidly in vacuum than in argon or H_2. Experiments to 3100°C in the reflection electron microscope showed surface crystallization and vaporization of the UO_2, and a tenfold increase in tungsten grain size, but no evidence of any UO_2–W interaction. Diametral tensile tests on impacted UO_2–W cermets showed a dependence of fracture mode and tensile strength on directions of impaction, grain orientation, and applied stress. Three high density plutonium cermets were prepared for irradiation testing: PuN–50 vol % W by pneumatic impaction, PuN–15 vol % Pu, and PuN–24 vol % Pu by arc melting. A UN–20 wt % PuN solid solution was prepared for irradiation testing by sintering pellets at 1800°C in 2/3 atmosphere of nitrogen for 5 hr. Pure UN pellets sintered in the same cycle reacted with the nitrogen and formed U_2N_3. UN–20 wt % PuN solid solution is compatible with AISI 304 SS at 1000°C. Irradiation effects upon plutonium compounds, compound mixtures, and cermets are being investigated. Materials under irradiation are PuN, PuC, PuO_2, β-Pu_2O_3, PuN–W cermets, and PuN–Pu cermets. Postirradiation examination of a UO_2 single crystal irradiated to 5×10^{20} fissions/cm^3 show: less than 0.12% fission gas release; lattice dilation of 0.071%; and no change in the UO_2 microstructure. A long-term, low temperature, irradiation study was begun on eight UO_2 specimens, including both preirradiated and nonirradiated samples, following examination by transmission replica electron microscopy. Many pores previously observed in large grains of irradiated UO_2 elements may actually be metallic uranium formed at the high temperatures during irradiation and subsequently removed by normal metallographic preparation. Fission products also concentrate in the areas of metallic inclusions. Thermal and electron beam etching characteristics of arc-fused uranium carbide appeared to be dependent on various crystal orientations within each grain. The pseudobinary systems PuC–TaC and PuC–ZrC were studied in an effort to find a high melting plutonium compound. Some evidence of partial solid solubility was found in the PuC–ZrC system. Melting points higher than 2300°C were measured with additions of 20 wt % ZrC. A pellet of PuN was sintered to 97% TD by heating for 1¼ hr at 1800°C under 2/3 atmosphere pressure of nitrogen. The first replicas for electron microscopy of a PuC–Ta cermet showed no evidence of interaction between the components, even after heat treatment at 1400°C for 11 hr in vacuum. (auth)

30114 (MLM-1188) INSPECTION AND RECANNING PROGRAM OF PuBe NEUTRON SOURCES. M. R. Hertz (Mound Lab., Miamisburg, Ohio). Jan. 7, 1964. Contract AT(33-1)-Gen-53. 20p.

The fabrication of $PuBe_{13}$ neutron sources with inner Ta containers and outer stainless steel casings is described. One such source (M-218) ruptured violently while its outer casing was being removed for replacement with a new one. The probable cause of the incident was determined to be the ingestion of water by the leaking inner container when the hot source was placed in a decontamination bath during fabrication. The fabrication procedure was modified to include a helium leak test. Most of the other neutron sources were returned for inspection, testing, and recanning. (D.L.C.)

30115 (ORNL-3619(p.61-83)) FUELED-GRAPHITE DEVELOPMENT. A. Goldman (Oak Ridge National Lab., Tenn.).

The characterization of unsupported pyrolytic-carbon-coated UO_2, ThO_2, $(U,Th)O_2$, U carbide, and (U,Th) carbide fuel pellets as regards chemical properties, uniformity of shape, and mechanical properties is reported. Methods for eddy-current inspection and microradiography of coated fuel particles are outlined. Apparatus for infrared inspection of graphite spheres for defects is described. The fabrication of fueled graphite is discussed. The effectiveness of chlorination of fueled graphite for removal of externally and internally exposed fuel is discussed. An analysis is made of the chemical compatibility of pyrolytic carbon coatings on UO_2, EuO_2, and sol-gel $(U,Th)O_2$, pellets. The ThC_2–UC_2 region of the Th–U–C phase diagram is studied. (T.F.H.)

30116 (ORNL-3619(p.123-46)) CLAD FUEL DEVELOPMENT. A. Goldman, O. Sisman, and D. B. Trauger (Oak Ridge National Lab., Tenn.).

Studies are made of: ratchetting effects and their amelioration in metal-clad ceramic fuel elements; tube-burst (stress-rupture) tests on tubes of Nb-stabilized stainless steel; thermal conductivity of UO_2, Armco iron, and graphite; radiation testing of clad fuel elements in ORR; and radiation effects on clad UO_2. (T.F.H.)

30117 (RTD-8-109(I)) TANTALUM ALLOY TUBING DEVELOPMENT PROGRAM. First Interim Technical Engineering Report, July 1, 1963–September 30, 1963. F. S. Turner (Allegheny Ludlum Steel Corp. Research Center, Brackenridge, Penna.). Oct. 1963. Contract AF33(657)-11261. 125p. (AD-427992)

A state-of-the-art analysis was completed covering potential application for, domestic and foreign technology used in the production of, and a review of mechanical and physical property data on tantalum alloy tubing. Usage was made of a questionnaire, personal visitations and contacts, and a review of domestic and foreign literature. (auth)

30118 (RTD-TDR-63-4006(Pt.I)) EVALUATION OF COATED REFRACTORY METAL FOILS. V. S. Moore and A. R. Stetson (Solar Aircraft Co., San Diego, Calif.). Sept. 1963. Contract AF33(657)-9443. 343p. (RDR-1325-4; AD-427764)

An evaluation program was made to determine the capabilities of various commercial coating vendors to coat effectively niobium and molybdenum alloy foils (0.006 in.). Two niobium based alloys (D36-Nb-10Ti-5Zr; B66-Nb-5Mo-5V-1Zr) and one molybdenum based alloy (TZM-Mo-0.5Ti-0.08Zr-0.02C) were included. Nine coating vendors participated in the program. Tests performed were receiving inspection (metallography, weight change, gross effects, and microhardness), mechanical properties at room temperature, bend ductility, ductile-brittle transition temperature, cyclic oxidation resistance in a furnace with and without prestraining and in a plasma-torch flame at 5 and 760 Torr, diffusion rates, creep, and fatigue life. Results show that foils can be coated to provide oxidation resistance up to 75 hours at 2500°F without gross loss in mechanical properties. (auth)

30119 (WANL-TME-654) ALUMINUM–BORON CONTROL PLATES FOR THE NERVA REACTORS; FABRICATION AND PROPERTIES. J. B. McAndrew (Westinghouse Electric Corp. Astronuclear Lab., Pittsburgh). Jan. 13, 1964. 27p.

The manufacturing procedures employed in producing control plates for Nerva reactors are similar to the production process developed by LASL for making Kiwi plates. Some changes have been made, however, to adapt the process to WANL equipment. These are described, and the manufacturing experience to date is discussed. Results of tensile tests, fatigue tests, and thermal expansion measurements are reported. (auth)

30120 (ANL-Trans-37) ON THE PREPARATION OF DEBYE-SCHERRER DIAGRAMS OF AIR-SENSITIVE ALLOYS. E. Zintl, A. Harder, and S. Neumayr. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from Z. Physik. Chem., 154A: 92-6(1931). 5p.

A device is described for the preparation of pure powder samples of highly hygroscopic or oxidizable substances. With this device, the samples can be pulverized and tempered in the absence of air. (D.L.C.)

30121 (NP-tr-1150) THE APPLICATIONS OF AUTORADIOGRAPHIC TECHNIQUES IN METALLURGY, AND THE STUDY OF SEGREGATIONS. F. Barigozzi and P. L. Lensi. Translated by L. F. Secretan (U.K.A.E.A., Atomic Energy Research Establishment, Harwell, Berks, England), from Met. Ital., 55: 129-44(Apr. 1963). 47p. (Includes original, 8p.).

Autoradiographic techniques used in metallurgy are discussed. The selection of emulsions for low, medium, and high magnifications is considered. Exposures and activities are discussed. The application of the autoradiographic techniques is illustrated by a study of segregation of P and S in steels. The results show that heat treatment homogenizes the P but not the S segregations. (D.L.C.)

30122 GROWTH OF TUNGSTEN MONOCRYSTALS ON GLOWED TUNGSTEN WIRES. T. W. Hoffmann and J. Nikliborc (Univ. of Wroclaw, Poland). Acta Phys. Polon., 25: 633-4(Apr. 1964).

Well shaped monocrystals were obtained by electrically glowing tungsten wire in a hydrogen atmosphere saturated with water vapor to a temperature of about 2500°C from 2 to 5 minutes. Variations of the number, shape, and orientation of the crystals with the temperature, surface, and time of glowing of the wire are discussed. (M.J.T.)

30123 ZONE-REFINING OF TRACERS-DOPED COPPER. A. Ascoli, E. Germagnoli, G. M. Schiavini, and C. Villa (Laboratori CISE, Milan). Nuovo Cimento (10), 32: 1450-3(June 1, 1964).

The separation of gold and cobalt impurities from copper by means of zone refining was investigated by means of a tracer technique. Tracers of ^{198}Au and ^{60}Co were used. The ^{60}Co was introduced into the copper by means of the neutron activation threshold reaction $^{63}Cu(n,\alpha)^{60}Co$. The zone refining was shown to be efficient even at concentration levels of the order of ppm. (C.E.S.)

30124 INVESTIGATION OF THE CONDITIONS OF OBTAINING CONGLOMERATED MOLYBDENUM POWDER. I. V. Koryakin and N. N. Bobkova. Poroshkovaya Met., Akad. Nauk Ukr. SSR, No. 2, 26-31(Mar.-Apr. 1964). (In Russian)

Conditions of molybdenum powder conglomeration were investigated in the process of the reduction of molybdenum dioxide with hydrogen. A study was made of the effects of the temperature and time of reduction, the quantity and moisture of the hydrogen, and the addition of potassium chloride and molybic anhydride to molybdenum dioxide on the quality and yield of conglomerated molybdenum powder of various fractions. The strongest effect on the conglomeration of molybdenum powder is exerted by the temperature and length of reduction. Conditions were elaborated for obtaining molybdenum powder with a maximum conglomerate yield of 40 to 70 μ. (auth)

30125 THERMAL PREPARATION OF ALUMINUM–CERIUM ALLOYS. V. A. Podergin and G. V. Samsonov. Tsvetn. Metal., No. 3, 59-62(Mar. 1964). (In Russian)

Thermal reduction of cerium dioxide in a vacuum by aluminum produced metallic cerium of 70 ± 5% purity. Reduction of cerium dioxide to metal with various molar ratios of Al at 1000 to 1600°C followed the reaction $CeO_2 + 2Al \rightarrow Ce + 2AlO$, forming a volatile aluminum oxide. Studies showed the most complete reduction at 1300°C. (R.V.J.)

30126 6e COLLOQUE DE MÉTALLURGIE. RELATIONS ENTRE DÉFAUTS A L'ÉCHELLE ATOMIQUE ET PROPRIÉTÉS MACROSCOPIQUES. (6th Metallurgy Symposium. Relations Between Atomic Defects and Macroscopic Properties). Gif-sur-Yvette, France, Centre d'Études Nucléaires de Saclay and Paris, Presses Universitaires de France, 1962. 225p.

Nineteen papers presented at the Sixth Metallurgy Symposium on the Relations between Atomic Defects and Macroscopic Properties are given. Separate abstracts were prepared for 11 of these papers. The remaining papers covered studies on the yield point of mild steels, kinetics of impurity diffusion in solids, recovery properties of aluminum alloys, recovery processes in cold-worked aluminum, interaction between hydrogen and structural defects in iron and extra-mild steels, brittleness of very pure iron at low temperatures, impurity distribution and mechanical properties of magnesium oxide, and effect of vacancy structure on autodiffusion of iron in iron protoxide. (M.C.G.)

For abstracts of individual papers see: 29671, 30162, 30222, 30223, 30224, 30225, 30226, 30260, 30261, 30262, and 30263.

Corrosion

30127 (ASD-TDR-62-934(Pt.II)) ADVANCEMENT OF HIGH-TEMPERATURE PROTECTIVE COATINGS FOR COLUMBIUM ALLOYS. [PART] II. D. B. Warmuth, J. D. Gadd, and R. A. Jefferys (Thompson Ramo Wooldridge Inc. TRW Electromechanical Div., Cleveland). Apr. 1964. Contract AF33(657)-7396. 209p.

The objective of this program was a) to advance and optimize the Cr–Ti–Si coating process for laboratory scale and pilot scale coating furnaces, b) to determine the protective reliability of the Cr–Ti–Si coating, and c) to investigate the effects of elevated temperature-reduced pressure (air) exposure upon the protective characteristics of the Cr–Ti–Si coating. In a process optimization study, the most protective Cr–Ti–Si coatings for cyclic oxidation in air at 1800, 2500, and 2700°F were formed utilizing the following process conditions. The Cr–Ti alloy layer was deposited in 8 hours at 2300°F in either a 50Cr–50Ti or a 60Cr–40Ti prealloyed powder pack. A system pressure of 1.5 mm was employed for the laboratory scale furnace and 10^{-2} mm for the pilot scale furnace. Siliconizing for 6 hours at 2100°F at a system pressure of 10^{-2} mm was considered optimum for both furnace sizes. In a reproducibility and reliability study a statistical analysis was conducted to determine the oxidation protective reliability of the Cr–Ti–Si coating on B-66 and D-43 alloys at 2000, 2500, and 2700°F. A high degree of reliability for the two Cr–Ti–Si coated alloys was established for 150 hours protective life at 2000°F, 28 to 32 hours protective life at 2500°F and 1 to 2 hours protective life at 2700°F. The protective reliability of the Cr–Ti–Si coating at either 2500 or 2700°F was found to be strongly dependent upon coating composition. An investigation to evaluate a completely vapor phase process for silicon deposition was conducted employing a gas flow process. Coatings potentially equal to those deposited in the vacuum pack process were formed by this technique. Extensive testing of the Cr–Ti–Si coating at pressures as low as 10^{-2} mm and temperatures to 2600°F was accomplished. The Cr–Ti–Si coating prevented visible niobium oxide growth for low pressure exposures up to 4 hours in duration. Post oxidation protective life at 1800 and 2500°F was unaffected by low pressure exposure at pressures greater than 1 mm. Exposure to pressures less than 1 mm caused varying degrees of loss of one atmosphere oxidation resistance at 1800 and 2500°F. The relationship of joint fabrication and coating process procedures was investigated relative to cyclic oxidation life. A detailed analysis of the work of the program and conclusions are presented. (auth)

30128 (BMI-X-288) THE EFFECT OF HEAT TREATMENT AND OF SALT COMPOSITION ON THE CORROSION OF INOR-8 AND HyMu-80 DURING HYDROFLUORINATION. P. D. Miller, E. F. Stephan, W. K. Boyd, and W. N. Stiegelmeyer (Battelle Memorial Inst., Columbus, Ohio). May 28, 1964. Contract [W-7405-eng-92]. 65p.

An investigation was conducted on the corrosion of INOR-8 and HyMu-80 in NaF–LiF–ZrF_4 at 650°C during the HF dissolution of Zircaloy-2 and Type 347 stainless steel. The salt compositions used were 37.5–37.5–25% for Zircaloy-2 dissolution and 52–37–11% for stainless steel dissolution. The results show that INOR-8 has a slightly better corrosion resistance than HyMu-80, and that the higher alkali metal fluoride content used in stainless steel dissolution is more corrosive. Initial salt purity and INOR-8 heat treatment had little effect on the corrosion. The difference in corrosion results when no metal was being dissolved was negligible for the 37.5–37.5–25% salt, but in the 52–37–11% salt, the attack at the interface was more severe when metal was being dissolved. (D.L.C.)

30129 (GEAP-4450) LOCALIZED CORROSION OF STAINLESS STEELS AND HIGH-NICKEL ALLOYS IN SIMULATED SUPERHEAT REACTOR ENVIRONMENT. W. L. Pearl, G. G. Gaul, and G. P. Wozadlo (General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.). Feb. 1964. Contract AT(04-3)-189. 68p.

A program was instituted to study and reproduce the in-reactor intergranular failures of Type-304 stainless steel fuel cladding found in superheated steam. The program was directed toward finding ways to eliminate the cause of failure or to use improved alloys that would be less susceptible to failure. A materials screening test was developed in the out-of-pile superheat facilities with 1.5 ppm chloride added as sodium chloride to the recirculating water in the presence of typical boiling-water reactor quantities of oxygen and hydrogen. During the test, the heater sheaths were exposed through several cycles to saturated steam (with its accompanying moisture carryover) and superheated steam. Failure of Type-304 stainless steel was obtained in periods of less than two weeks; the failures were predominantly transgranular. Type-347 and vacuum-melted Type-304 stainless steels failed in this NaCl-cycle test while Inconel-600, Incoloy-800, Hastelloy-X, Type-406 stainless steel, and vacuum-melted Type-310 stainless steel were acceptable. An improved chloride cycle test with 0.5 ppm chloride added as ferric chloride to the recirculating water was developed. An intergranular failure was obtained similar to that experienced in the superheat fuel cladding failures in the superheat in-pile loops in the Vallecitos Boiling-Water Reactor. Sensitized Type-304 and Type-316 stainless steels failed intergranularly in this test. Inconel-600, Incoloy-800, and vacuum-melted Type-310 stainless steel did not fail when exposed to the test for much longer time periods. During the development and performance of the cycle runs, the superheat facilities were exposed to a myriad of conditions within the extremes of the test parameters involved. Intergranular chemical attack was experienced essentially independent of stress, but the attack was generally distributed. In the presence of high stress, the intergranular attack was more localized and advanced normal to the stress. It is hypothesized that a definite interplay exists between chemical attack and stress, and that the application of the stress increases the rate of the intergranular attack preferentially in a direction perpendicular to the stress. (auth)

30130 (GEAP-4495) GENERAL CORROSION OF INCOLOY-800 IN SIMULATED SUPERHEAT REACTOR

ENVIRONMENT. W. L. Pearl, E. G. Brush, G. G. Gaul, and G. P. Wozadlo (General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.). Mar. 1964. Contract AT(04-3)-189. 76p.

The following conclusions are based on the out-of-pile general corrosion evaluations completed to date on Incoloy-800 as a fuel cladding for nuclear superheat applications: (1) The corrosion data from 4000-hour heat transfer tests indicate good corrosion resistance up to at least a 1300°F metal temperature. By use of a devised method of data treatment, the general corrosion for three-years exposure at 1300°F can be calculated to average 0.0016 inch with an upper 95% confidence limit of 0.0033 inch. (2) A compositionally disturbed layer develops at the metal-oxide interface. The disturbed layer depth is a function of time and temperature of exposure. The most pessimistic interpretation of the growth rate with time would indicate a layer depth of 0.0017 inch after a three-years exposure at 1300°F. The possible effects of such a layer on cyclic type exposures (i.e., cyclic strain, corrosion fatigue, etc.) have not been evaluated. (3) The corrosion results indicate excellent corrosion resistance of Incoloy-800 when exposed isothermally to steam generated from a simulated BWR and superheated to 1150°F. Corrosion rates of 3.6 ± 1.2 mg/dm^2-month at 1050°F and 10 ± 18 mg/dm^2-month at 1150°F are applicable in such exposures with a steam velocity of 20 ft/sec. (4) The potential activity problem from metal-to-system losses increases in significance with increase in metal temperature (especially above 1100°F) and increase in exposure time. At least one-half of the oxide formed on metal operating at temperatures between 1200 and 1300°F will be carried downstream from the cladding. (5) Additional exposures of Incoloy-800 sheaths as heat transfer specimens at metal temperatures of 1200 to 1400°F are required to permit more accurate extrapolation of the higher temperature corrosion rate and corrosion-product-release rate data and to establish the ratio of alloy constituents lost to the system over time periods of about three years. (auth)

30131 (MSAR-64-65) EFFECT OF HIGH-TEMPERATURE SODIUM ON AUSTENITIC AND FERRITIC STEELS. PHYSICAL PROPERTIES OF MATERIALS. Progress Report No. 45, May 1964. (MSA Research Corp., Callery, Penna.). June 19, 1964. Contract AT(11-1)-765. 15p.

The effects of air, helium, and sodium on the mechanical properties of chromium–molybdenum steel and type 316 stainless steel are evaluated. The effects of carbon and oxygen contaminants in the corrosion loops are analyzed. (N.W.R.)

30132 (NASA-CR-54081) POTASSIUM CORROSION TEST LOOP DEVELOPMENT. Quarterly Progress Report No. 3, January 15–April 15, 1964. E. E. Hoffman, ed. (General Electric Co. Missile and Space Div., Cincinnati). Contract NAS-3-2547. 78p.

The development of a Nb–Zr corrosion test loop is described. Na is heated electrically in an auxiliary loop, and is used to boil K in the primary loop. The primary loop is used to study the corrosive effects of boiling and condensing K on refractory alloys. The design, construction, and testing of several prototype corrosion loops are described. (T.F.H.)

30133 (WCAP-3737) A LONG TERM CORROSION TEST OF REACTOR STRUCTURAL MATERIALS IN A CHEMICAL SHIM SOLUTION. D. D. Whyte (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). Mar. 1964. Contract AT(30-1)-3064. 37p.

Various nuclear reactor structural materials were tested for 9 months at 600°F in a 1550 ppm boron (as boric acid), 5.7 ppm potassium (as potassium hydroxide) solution in a loop. Zirconium–beryllium braze on Zircaloy-4 and nickel plate on silver–indium–cadmium alloy appeared to exhibit excessive corrosion. Thick layers of Nicrobraz-50 on type 304 stainless steel promote cracking and some pitting of the braze material, indicating that close tolerances between pieces to be brazed are required. The 304 and 400 series stainless steels tested behaved satisfactorily considering their proposed uses in reactors containing soluble chemical neutron absorbers in the coolant. Inconel also appears acceptable for steam generator tubing from the point of view of general corrosion. (auth)

30134 (EURAEC-955) EXAMINATION OF ZIRCONIUM HYDRIDE IN ZIRCALOY 2 AND ZrNb ALLOYS. Quarterly Report No. 9, October 1–December 31, 1963. (Siemens-Schuckertwerke A. G., Erlangen, Germany). Work Performed under United States–Euratom Joint Research and Development Program. Contract 024-61-10 RDA. 28p. (A translation)

Data on the corrosion, hydridation, oxide-layer-formation, and mechanical properties changes in Zircaloy-2, Nb–Zr, Zr–Cu–Mo, and Zr–Cu–Nb are presented. (T.F.H.)

30135 (EURAEC-1047) STUDIES OF STEEL CORROSION IN HIGH-TEMPERATURE WATER AND STEAM. Quarterly Report No. 7, January 1–March 31, 1964. (Société d'Études, de Recherches et d'Applications pour l'Industrie, Brussels). Apr. 30, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 089-62-7-RDB. 113p. (A translation)

The static corrosion tests on stainless steel AISI 304 in high-temperature water and steam were continued in two directions: on the one hand, research into the interaction of surface state, temperature, and physical state of the water; and on the other hand, research into the surface state characteristic factor, the influence of which is predominant in terms of the oxidation conditions. (T.F.H.)

30136 (EURAEC-1061) DESCRIPTION OF A LOOP MEANT FOR DYNAMIC CORROSION TESTS IN WATER AT HIGH TEMPERATURE. Special Report No. 2. W. Vanmol, R. Hennaut, J. Waty, and W. R. Ruston (Société d'Études, de Recherches et d'Applications pour l'Industrie, Brussels). Apr. 10, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 089-62-7-RDB. 33p. (A translation)

The loop is especially meant to allow dynamic corrosion tests, at high temperature, in very pure water or in water containing additives. The maximum values of the test parameters are: temperature: 335°C, total pressure: 170 kg/cm^2, flow: 25m^3/hr, water circulation speed along the samples in the present disposition of the test sections: 10 m/sec. The operation principle of the installation is fully described. The whole of the material and equipments which constitute the main and secondary circuits is completely realized in stainless steel. The equipment of the main and auxiliary circuits, as well as their layout and interconnections are described. The description of the electrical control auxiliaries, of alarms and automatic safety devices completes the characteristics of the installation. The loop operation is illustrated by the description of a short operating manual. (auth)

30137 THE CORROSION OF URANIUM, ZIRCONIUM, AND SOME ALLOYS IN ALKALINE SOLUTIONS. J. S. Llewelyn Leach and A. Y. Nehru (Imperial Coll. of Science and Tech., London). J. Electrochem. Soc., 111: 781-7 (July 1964).

The corrosion of uranium, zirconium, and an uranium–

zirconium alloy was studied as a function of potential in some alkaline solutions. The behavior of zirconium was found to be in qualitative agreement with results previously obtained in more acid solutions. The interpretation of the data for uranium and the alloy involved assumptions concerning changes in the nature of the protective oxide layer associated with changes in the formation potential. Such differences are now shown on the pH-potential diagram generally accepted for the uranium–water system and a new diagram was derived. Electron diffraction measurements were employed in an attempt to verify the present interpretation. (auth)

30138 THE EFFECT OF HEAT-TREATMENT ON THE CORROSION AND HYDROGEN PICKUP BEHAVIOR OF A Zr–Sn–Nb ALLOY IN HIGH TEMPERATURE WATER AND STEAM. D. L. Douglass (General Electric Co., Pleasanton, Calif.) and H. A. Fisch. J. Electrochem. Soc., 111: 787-95(July 1964).

Heat-treatment was shown to increase the rate of corrosion of Zr–2Sn–2Nb alloy over that of the annealed condition, but the rate of hydrogen pickup as a function of total corrosion was found to be relatively insensitive to heat treatment. The effects of heat treatment were analyzed in terms of changes in: alloy constitution, composition of microconstituents, and the metal texture and oxide orientation. Stereoscopic examination of oxide-film surfaces by electron microscopy revealed cracking both at grain boundaries and at interfaces between phases. Extensive and abrupt changes in film topography, which also were sites of film cracking, were observed. (auth)

30139 THE OXIDATION KINETICS OF ZIRCONIUM DIBORIDE AND ZIRCONIUM CARBIDE AT HIGH TEMPERATURES. A. K. Kuriakose and J. L. Margrave (Univ. of Wisconsin, Madison). J. Electrochem. Soc., 111: 827-31(July 1964).

Kinetic studies were made of the oxidation of zirconium diboride at 945 to 1256°C, and of zirconium carbide at 554 to 652°C. The $ZrB_2–O_2$ reaction was parabolic throughout the temperature range studied, whereas the $ZrC–O_2$ reaction was linear. In the former case ZrO_2, together with a molten layer of boron oxide, was formed, which protected against further direct attack of oxygen on the ZrB_2, while in the latter, a rather porous film of zirconium oxide was formed, which was not protective. The rate of oxidation of ZrB_2 was directly proportional to the oxygen partial pressure between 102 and 744 mm. (auth)

30140 EFFECTS OF ZIRCONIUM ON CORROSION RESISTANCE OF STEEL. V. S. Kovalenko and E. L. Zats (Don Research Inst. of Ferrous Metals, Academy of Sciences, USSR). Metalloved. i Term. Obrabotka Metal., No. 4, 30-1(Apr. 1964). (In Russian)

The corrosion resistance of carbon steel with 0.10 to 0.16% Zr in water is much higher than steel without zirconium. The improved corrosion resistance is due to the lowered anodic activity. Zirconium affects the cathode process by forming a large number of microcathodes. (R.V.J.)

30141 OXIDATION OF TUNGSTEN–RHENIUM ALLOYS. R. F. Voitovich and V. A. Lavrenko (Inst. of Metal Ceramics and Special Alloys, Academy of Sciences, Ukrainian SSR). Metalloved. i Term. Obrabotka Metal., No. 4, 50-1(Apr. 1964). (In Russian)

Studies of W–Re alloys (5 to 20% Re) at 500 to 900°C indicated a simultaneous oxidation and evaporation. With 5% Re the oxidation of recrystallized specimens begins below 700°C. Above 700°C the oxidation increases forming $\alpha' - WO_3$ in a clinker phase with a high concentration of anion vacancies in the lattice. A large admixture of Re (20%) also increases the rate of oxidation at temperatures over 700°C. The oxidation has a specific appearance with an obvious sublimation of the clinker scale. (R.V.J.)

30142 UC–ZrC (NbC) AS A REACTOR FUEL MATERIAL. Kazuo Yamamoto (Mitsubishi Atomic Power Industry, Inc., Cmiya, Japan). Nippon Genshiryoku Gakkaishi, 6: 197-205(Apr. 1964). (In Japanese)

As an attempt to improve the stability of U-carbide fuel, the solid solutions UC-ZrC and UC-NbC were studied. Their stabilities against corrosion by water and atmospheric oxidation and their compatibility with graphite were compared with those of UC and UC_2. The $UO_2 + C + ZrC$ or $UO_2 + C + NbC$ mixture was heated in vacuum at around 1800°C for 1 hr to form the solid solution. By milling and compacting the reacted carbide and sintering in vacuum at 1900 to 2000°C for 1 hr, UC-ZrC or UC-NbC pellets with a density of more than 90% of theoretical value were produced. It was revealed that UC_2 tended to decompose into C and U_2C_3 in the temperature range lower than 1500°C and transformed from a cubic to tetragonal lattice at about 1800°C, although it was compatible with graphite up to 2000°C. Neither (UZr)C nor (UNb)C showed lattice transformations up to their melting points. They also showed excellent stabilities against corrosion and oxidation, and were compatible with graphite up to 2000°C, as long as the ZrC or NbC content was more than 72 or 63 mol %. These mixed carbides were found to be promising as a fuel material for a high-temperature gas-cooled reactor. (auth)

30143 FUEL CLADDING CORROSION TESTING IN SIMULATED SUPERHEATER REACTOR ENVIRONMENT: PHASE-II. LOCALIZED CORROSION OF STAINLESS STEELS AND HIGH NICKEL ALLOYS. W. L. Pearl, G. G. Gaul, and G. P. Wozadlo (General Electric Co., San Jose, Calif.). Nucl. Sci. Eng., 19: 274-95(July 1964).

A program was instituted to study and reproduce the in-reactor intergranular failures of Type-304 stainless steel fuel cladding found in superheated steam. The program was directed toward finding ways to eliminate the cause of failure or to use improved alloys that would be less susceptible to failure. A materials screening test was developed in the out-of-pile superheat facilities with 1.5 parts/10^6 chloride added as sodium chloride to the recirculating water in the presence of typical boiling-water-reactor quantities of oxygen and hydrogen. During the test, the heater sheaths were exposed through several cycles to saturated steam (with its accompanying moisture carryover) and superheated steam. Failure of Type-304 stainless steel was obtained in periods of less than two weeks; the failures were predominantly transgranular. Type-347 and vacuum-melted Type-304 stainless steels failed in this NaCl-cycle test while Inconel-600, Incoloy-800, Hastelloy-X, Type-406 stainless steel, and vacuum-melted Type-310 stainless steel were acceptable. An improved chloride cycle test utilizing 0.5 parts/10^6 chloride added as ferric chloride to the recirculating water was developed. An intergranular failure was obtained similar to that experienced in the superheat fuel cladding failures in the superheat in-pile loops in the Vallecitos Boiling Reactor. Sensitized Type-304 and Type-316 stainless steels failed intergranularly in this test. Inconel-600, Incoloy-800, and vacuum-melted Type-310 stainless steel did not fail when exposed to the test for much longer times. During the development and performance of the cycle runs, the superheat facilities were exposed to a myriad of conditions within the extremes of the test parameters involved. Intergranular chemical attack was experienced essentially

independent of stress, but the attack was generally distributed. In the presence of high stress, the intergranular attack was more localized and advanced normal to the stress. This suggests that a definite interplay exists between chemical attack and stress, and that the application of the stress increases the rate of the intergranular attack preferentially in a direction perpendicular to the stress. (auth)

30144 STRAIN-INDUCED BIREFRINGENCE IN FLUORIDE FILMS ON URANIUM DIOXIDE. W. P. Ellis (Los Alamos Scientific Lab., N. Mex.). Science, 144: 1570-2 (June 26, 1964). (LADC-6204)

Optically birefringent microstructures are formed within fluoride films that are produced on uranium dioxide by hydrofluorination. The positive molar volume change of the reaction produces nonuniform tensile and compressive stresses around sites of surface roughness that result in optical double refraction. (auth)

Fabrication

30145 (AD-401528) THE INVESTIGATION OF THE ACTIVATED SINTERING OF TUNGSTEN POWDER. Final Report, November 1, 1961–January 31, 1963. J. H. Brophy, H. W. Hayden, A. L. Prill, and J. Wulff (Massachusetts Inst. of Tech., Cambridge). Feb. 28, 1963. Contract NO w61-0326-d. 121p.

Low temperature densification of tungsten can be accelerated by additions of palladium, rhodium, ruthenium, and platinum in a manner similar to that observed with nickel additions. The cause for this acceleration is an enhancement of the grain boundary diffusion process found to dominate the densification of commercially pure tungsten in the same temperature range. In contrast to the other Group VIII elements examined, iridium retards the densification of tungsten at 1100°C. An analysis of activated solid state sintering and more conventional liquid phase sintering in tungsten indicates that the two processes are similar and together comprise a general phenomenon called carrier phase sintering. (auth)

30146 (AD-414497) PROCESSING AND EVALUATION OF PRE-PRODUCTION QUANTITIES OF COLUMBIUM ALLOY SHEET. Interim Report No. 2, April 24, 1963–July 23, 1963. (Westinghouse Electric Corp., Blairsville, Penna.). Aug. 20, 1963. Contract N 600(19)-59546. 14p.

A 0.155-inch B-66 sheet was processed to 0.050 inch. The yield of 46.4% from extrusion billet compares favorably with yields for other columbium alloys which are generally less difficult to fabricate. Sheet flatness was 3.1% maximum. Gage uniformity and AMS specifications were generally met. An FS-85 ingot, $6^{3}/_{4}$-inches in diameter and weighing 303 pounds, was readily forged to $2^{5}/_{8}$-inch thick slab and a high yield of material is expected from this operation. (auth)

30147 (AD-430303) PRODUCTION ENGINEERING MEASURE FOR BERYLLIUM OXIDE AND PARTS PRODUCED FROM IMPORTED ORES. Quarterly Progress Report No. 1, July 1–September 30, 1963. J. F. Blum (Beryllium Corp., Reading, Penna.). Contract DA-36-039-AMC-01481(E). 23p.

High-purity beryllium oxide powder production is summarized. (auth)

30148 (BMI-1275) EXAMINATION OF FACTORS AFFECTING THE QUALITY OF VACUUM-INDUCTION-MELTED URANIUM. Roy W. Endebrock, Ellis L. Foster, Jr., and Ronald F. Dickerson (Battelle Memorial Inst., Columbus, Ohio). July 3, 1958. Contract W-7405-eng-92. 53p.

Uranium melting was investigated to determine what reactions, variable in nature, could be determined to ingot purity or soundness. Experiments were conducted with 10-lb uranium charges in a vacuum induction furnace 1200 liters in volume. A special manifold allowed sampling of the furnace atmosphere for mass spectrometer analyses at appropriate times after the furnace was isolated from the vacuum system. Melts were made with a selected production grade of pure uranium. The program included (1) exploratory melts in graphite with and without MgO crucible dressings, (2) melts in graphite and zirconia crucibles under dry and wet furnace conditions, (3) replicate experiments in which known quantities of hydrogen, nitrogen, CO, oxygen, CO_2, H_2O, and argon were each admitted to the furnace to determine pressure-time relationships and residual-gas compositions, and (4) a demonstration of the water-gas reaction within the furnace. The MgO crucible dressing tended to peel during initial outgassing. During the melting cycle, MgO was reduced and formed a black magnesium deposit within the furnace. Gases and, especially, water vapor adsorbed by graphite components were difficult to remove. To lower the outgas rate at 2500°F from 3 to 0.45 μ per min, it was necessary to heat the crucible for 5.5 hr in the 2500 to 3100°F temperature range at 1×10^{-4} mm of mercury. Water and graphite at elevated temperatures produced hydrogen and CO, the products of the water-gas reaction. A secondary reaction between CO and uranium resulted in a furnace atmosphere that was mainly hydrogen. Temperature variations between surface and subsurface metal were large. Optical temperature determinations were affected by dross and varied considerably with dross thickness. The integrity of the surface dross was a controlling factor of the composition and amount of reactive gas remaining over the melt and of the ability to reproduce data. From a thermodynamic viewpoint, small changes in CO partial pressure over the melt will result in large changes in the carbon–oxygen level of the melt, and the contribution of CO to contamination can be greater through this mechanism than by the direct CO–uranium reaction. (auth)

30149 (DP-443) COEXTRUSION OF POWDER-COMPACT SLUGS. Harold G. Marsh (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Apr. 1960. Contract AT(07-2)-1. 13p.

A process was developed for manufacturing aluminum-clad slugs containing UO_2 or ThO_2 dispersed in an aluminum matrix. In this process, a mixture or the oxide and aluminum powder is cold compacted to form the billet core, which is then coextruded with an aluminum sheath to produce the clad slug. (auth)

30150 (EUR-8.f) PRODUCTION DE PASTILLES D'OXYDES MIXTES UO_2–ThO_2 PAR FRITTAGE DANS L'AIR. (Fabrication of Mixed UO_2–ThO_2 Pellets by Sintering in Air). M. Mattys (European Atomic Energy Community) and R. Hauser (Compagnie Industrielle des Combustibles Atomiques Frittes, Corbeville, par Orsay (Seine-et-Olse), France). Mar. 1962. Contract 014-60-9-RDI. 36p.

Sintering, both in air and in cracked ammonia, makes it possible to obtain high-density uranium and thorium mixtures (over 96% t.d.). Sintering in air at 1600°C yields ThO_2–$UO_{2.3}$ solid solutions, while in hydrogen atmosphere ThO_2–$UO_{2.00}$ solid solutions are obtained. The extent to which the sintering process is a success depends on the choice of the source materials. Mixed ThO_2–U_3O_8 pre-

cipitates yield remarkable results in hydrogen sintering, the addition of CaO making it possible to drop the temperature to 1400°C. The UO_3-ThO_2 mixture is most appropriate for air sintering. The homogeneity of the source mixture is an essential prerequisite for the success of the sintering process. A study has been made of the effect produced by the shaping conditions on the post-sintering density and on the structure. The influence of various additives was also examined: 0 to 15% uranium oxide and 0 to 0.4% CaO. (auth)

30151 (EUR-117.e) SWAGING OF URANIUM DIOXIDE. G. Frigerio (FIAT. Sezione Energie Nucleare, Turin). 1962. 44p.

Main objective of the work program was to study on a small pilot plant scale the reproducibility of data obtained with the following vibro-swaging process: pneumatical vibration (4 minutes duration) to reach a UO_2 density of approximately 84% of theoretical followed by two passes through the swager without intermediate annealing for a reduction of total area of approximately 18%. More than one hundred rods of reactor length (125–190 cm) were fabricated. For both stainless steel and Zircaloy-2 rods the reproducibility of the UO_2 average density was (92.5 ± 0.5)% T.D. Spread of density values along the rod length referred to the average density was (+0.5 – 1.5)% T.D. or better. Spread of final active length was ±1.3 cm or better. In one lot of fused UO_2 the fragmentation behavior was found to be such that it was not possible to obtain densities higher than 90 per cent of theoretical. Therefore, some concern still remains on the constancy of the compacting behavior of different fused UO_2 lots. From the present work, indicative conclusions can be drawn on the fabrication cost of the vibro-swaged UO_2 fuel as compared to the pelletized UO_2 fuel. The estimated figures of 12–14 $/kg U in favor of the swaged fuel seem to be interesting for the problem of decreasing the fuel cost. A "stationary" technique was chosen for measuring the out-of-pile thermal conductivity of swaged UO_2. Assuming as a comparison base the values reported by Deem and Lucks for UO_2 pellets, the thermal conductivity values for swaged UO_2 seem to remain lower by approximately (25 + 0–10)% than the thermal conductivity values for pellets at the same density (90% T.D.) and at temperatures between 150 and 800°C. Additional studies have been performed on the fragmentation behavior of fused UO_2 during vibration and swaging, porosimetry of swaged UO_2, roughness of cladding internal surface, and hardness of cladding. (auth)

30152 (HW-79843) FABRICATION OF ZIRCALOY-2 CLAD THORIUM–URANIUM ALLOY FUEL ELEMENTS. R. S. Kemper, R. N. Johnson, J. E. Minor, and R. G. Nelson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 1964. Contract AT(45-1)-1350. 77p.

The fabrication procedures used to produce Th–2.5 wt % U–1.0 wt % Zr Zircaloy-2 clad tubular fuel elements are described. These include vacuum-consumable arc melting, coextrusion, material evaluation, end-closure brazing, and cleaning procedures. Conditions for irradiating the fuel elements are also given. (auth)

30153 (ORNL-3619(p.84-122)) INVESTIGATIONS OF FUELED-GRAPHITE SYSTEMS. O. Sisman, H. W. Savage, D. B. Trauger, and G. M. Watson (Oak Ridge National Lab., Tenn.).

Studies are reported of: fission-gas release from pyrolytic-carbon-coated U-carbide and (Th,U)-carbide fuel pellets; fission-product deposition and adsorption in gas-coolant systems; ex-pile-loop tests of fission-product deposition; analytical models for fission-product deposition; initial U concentrations in unfueled graphite shells of German fueled-graphite spheres; oxidation of fueled and unfueled graphite spheres in water vapor; and diffusion of Th, Pa, and U in pyrolytic carbon. (T.F.H.)

30154 (USBM-U-1107) SOLID-STATE DIFFUSION BONDING OF COLUMBIUM WITH INTERFACIAL MATERIALS AT TEMPERATURES OF 1,050 TO 1,375°C. R. Blickensderfer and H. Kato (Bureau of Mines. Albany Metallurgy Research Center, Ore.). Jan. 1964. Contract AT(11-1)-599. 36p.

Cold-worked niobium, in the form of ¼-inch-diameter rod, was diffusion bonded under relatively low contact pressure, relatively low temperature, and under vacuum of less than 10^{-4} mm mercury. Thin coatings of various metals were tried on the interface to promote bonding. Indium and nickel were the most promising since fairly good bonds were made at 1100°C. This is more than 200°C below the expected diffusion temperature for plain niobium–niobium. Bonding temperature was more important than time of contact in producing strong bonds. Bonds made at 1100°C showed partial recrystallization of the niobium in the region of the interface and had tensile strength of around 15,000 psi. A bond produced at 1250°C was stronger than the parent metal (26,800 psi). Bonds with more than a nominal strength could not be produced by treatments below 1075°C. (auth)

30155 (EURAEC-792) NUCLEAR VAPOTRON. Quarterly Report No. 5, April–June 1963. (Compagnie Francaise Thomson-Houston, Paris; Societe Alsthom. Paris; and Allgemeine Elektrizitatsgesellschaft, Frankfurt am Main). Work Performed under United States–Euratom Joint Research and Development Program. Contract 050-62-5 RDC. 29p. (A translation)

The nuclear vapotron is a means for canning boiling-water-reactor fuels with a container having an irregular outer cross section, for the purpose of stabilizing the heat transfer characteristics on the fuel-can surface. The can cross section may be gear-toothed, thick-finned, wavy, etc. Test results and techniques for the vapotron configurations are summarized. (T.F.H.)

30156 (EURAEC-914) A STUDY ON THE RESIDUAL STRESSES PRODUCED BY THE ASCENDING VERTICAL WELDING PROCESS. Quarterly Report No. 8, October 1–December 31, 1963. (Arcos, S. A., Brussels). Work Performed under United States–Euratom Joint Research and Development Program. Contract 053-61-12-RDB. 71p. (A translation)

Deep stresses were determined by two different methods: the Gunnert method, by means of cross bases and TΔ bases; and the triaxial measurement method. The completion of these measurements made it possible to carry out the cuttings perpendicularly to the couples for measurement of the real distances of the couples and the establishment of the diagrams for the recording and distribution of the temperatures. A test-piece measuring 100 mm was welded onto two wires. The report gives the welding parameters, the thermal balance, and the results of the deformation measurements. An additional release of the stresses was operated by cutting a few measuring blocks into thinner slabs. This operation was performed on 30-mm-thick test-pieces, as well as on 60-mm-thick test-pieces. (auth)

30157 (EURAEC-933) SINTERED URANIUM OXIDE: SINTERING TECHNIQUES [AND] BEHAVIOR UNDER IRRADIATION. Quarterly Report No. 13, October 1–December 31, 1963. (France. Commissariat à l'Énergie

Atomique, Paris). Work Performed under United States–Euratom Joint Research and Development Program. Contract 031-60-10-RDF. 91p. (A translation)

The study of grain growth kinetics on experimental and industrial samples of sintered UO_2 was completed by annealing for 500 hours at 1600 and 1800°C, after which the grain reaches an average size of 40 to 90/u. Precipitations of uranium are found in the UO_2 after such treatment is performed in an inert atmosphere in the presence of a tantalum resistor. Tests have been carried out to determine the importance of the oxidations expected on the surface of sintered UO_2 when cooling down in atmospheres which contain oxidizing elements. An irradiation experiment to determine the thermal conductivity of UO_2 was carried out in EL3, by raising the power of the reactor by stages, with the maintenance of maximum power for 3 days, followed by a gradual descent; then another gradual power rise with maximum power maintained for 25 1/2 days, and finally, after normal shutdown of EL3, the slug was subjected to a second reactor cycle at maximum power for 32 days. Measurements of small surfaces by adsorption of a mixture of natural xenon and xenon-133 are being pursued at the temperature of liquid nitrogen. The value of the saturating vapor tension of the xenon has been determined at that temperature. Fairly reproducible measurements were taken of BET surfaces of glass and of small samples (50 mg) of sintered uranium dioxide with variable densities and microstructures. Experiments carried out in the Medicis loop made it possible to measure quantities of ^{135}Xe and ^{133}Xe in equilibrium with microsamples of sintered UO_2 maintained at a constant temperature. In particular, the fraction f (defined as the ratio between the number of emitted atoms and the number of atoms formed from a given isotope) can be evaluated. Four slugs fitted with can thermocouples for instantaneous power measurement have been prepared for irradiation in EL3 up to approximately 5000 Mwd/t. (auth)

30158 (EURAEC-1036) PROCEDURE FOR MANUFACTURING PRESSURE VESSELS. Quarterly Report No. 7, January 1–March 31, 1964. (Neratoom, N. V., The Hague). Work Performed under United States–Euratom Joint Research and Development Program. Contract 069-61-12 RDN. 24p. (A translation)

Welding and weld inspection techniques for steel pressure vessels are developed. (T.F.H.)

30159 (EURAEC-1067) PREPARATION OF UO_2 POWDERS OF HIGH BULK DENSITY BY FUSING AND GRINDING AND THEIR TRANSFORMATION INTO FUEL ELEMENTS. Quarterly Report No. 13, January 1–March 31, 1964. (Nuklear-Chemie und-Metallurgie G.m.b.H., Wolfgang bei Hanau am Main, Germany). Work Performed under United States–Euratom Joint Research and Development Program. Contract 013-63-7 TEED. 28p. (A translation)

The quantitative balance sheet of the melting process was improved, i.e., the waste per melt was reduced to 50 g. Changes in the melting time and in the electrode diameter did not improve the yield. The evolution of temperature in the pellets was measured during the heating period, and it was found thereby that pellets with a diameter of about 130 mm could be fused, which would make it possible to increase the yield still more. It was found necessary to purify the sinter refluxed in the melting process, after its grinding. The amount of iron impurities caused by the grinding process could be reduced to about half by a magnetic cleaning process. A closer examination of melted UO_2 revealed the fact that the iron abrasion is mainly to be found in the finest part of the powder, although the amount of impurity, referred to the total amount of powder, remains within the limit of the usual fuel specifications. An absorption of oxygen during grinding certainly does not occur with particles >0.030 mm. The gas content of UO_2 fused in an atmosphere of nitrogen was found to lie between 10 and 16 ppm of H_2 and 150 to 210 ppm of N_2, whereas the amounts for substance melted in an atmosphere of argon were found to be respectively 7 to 10 ppm of H_2 and 25 to 80 ppm of N_2. The influence of disturbances in the vibration process, such as interruptions of the compaction and simulated unmixing of the powders, upon the density distribution in the tube was investigated, as well as the influence of long vibration periods on the average density and density variations. Ultrasonic tests for investigating the damage caused to canning tubes by the vibration densification did not reveal any measurable changes of the surface with respect to the initial condition. (auth)

30160 MEASURING OF CORROSION OF AUSTENITIC STAINLESS STEELS AND OF ALUMINUM BY AN AFFIXED SOURCE OF RADIATION. František Voženílek and Pavel Kovář (Nuclear Research Inst., Czechoslovak Academy of Sciences, Rez). Jaderna Energie, 10: 90-2(Mar. 1964). (In Czech.)

The problem of corrosion of materials of construction used in an atomic reactor was studied. Non-magnetic austenitic stainless steel and aluminum were used in the construction. Cr was found in the circulation water. The rate of corrosion was determined by affixed radiation sources. The source has to have a shape corresponding to the shape of the investigated vessel. The mechanical position of the apparatus has to be exactly fixed. The calibration of the scale must be made according to the thickness of the investigated vessel wall. Five to 10 measurements should be made and the average value taken. Temperature and other conditions must be maintained during all the series of experiments. (OTS)

30161 A NEW METHOD FOR PREPARATION OF STRAIN-FREE SINGLE-CRYSTAL TENSILE SAMPLES OF HIGH-MELTING METALS AND SOME RESULTS ON THE PLASTIC DEFORMATION OF NIOBIUM SINGLE CRYSTALS. E. Votava (Union Carbide European Research Associates, Brussels). Phys. Status Solidi, 5: 421-34 (1964). (In German)

A method is described for the direct production of strain-free (tensile) specimens of high melting-point metals by electron-beam zone-melting. Measurements of the purity of such crystals showed that purification occurs mainly by the evaporation of impurities, accompanied by a relatively small zone-melting effect. Tensile tests on niobium single crystals, prepared in this way, showed that the plastic properties depend strongly on orientation. Thus, for the three corner-orientations, the ⟨100⟩-orientation had the highest U.T.S. and the highest uniform and total elongation, and also showed a two-step work-hardening rate. The ⟨110⟩-orientation had only a one-step, but steep, work-hardening rate. For the ⟨111⟩-orientation no uniform type of curve could be found; this orientation showed the effect of "repeated work softening." For orientations inside the stereographic triangle the development of an "easy glide" range was observed. This range was, however, somewhat different according to whether the crystal axes were shifted from the ⟨100⟩- or ⟨110⟩-orientation. The "easy glide" range was followed by appreciable work hardening, and in a later stage by a recovery range. The center of the "easy glide" range seemed to lie near the ⟨123⟩-orientation. All, the niobium single crystals investigated showed pronounced yield points, the yield-point drop depending on the orienta-

tion and perfection of the crystal. The ⟨111⟩-orientation had the smallest, and the ⟨110⟩-orientation the largest yield-point drop. In addition a tendency was observed for large yield-point drops to occur along the line ⟨110⟩–⟨112⟩. These results are discussed with regard to the possible active slip planes; the observed yield-point effects are explained by the behavior of dislocations between the upper and lower yield points. (auth)

30162 RECRYSTALLIZATION OF URANIUM PURIFIED BY ZONE MELTING. G. Clottes and J. P. Mustelier (CEN, Saclay, France). p.69-74 of "6e Colloque de Métallurgie. Relations Entre Défauts a l'Échelle Atomique et Propriétés Macroscopiques." Gif-sur-Yvette, France, Centre d'Études Nucléaires de Saclay and Paris, Presses Universitaires de France, 1962. (In French)

Uranium purified by zone melting was cold rolled to 80%. The sample was then successively annealed at different temperatures. Four experimental methods allowed determination of the recrystallization temperature of 270°C and of an important grain growth. (auth)

Properties and Structure

Refer also to abstracts 29657, 30479, and 30687.

30163 (62RL-3145(M)) ELECTRONIC STRUCTURE AND THE PROPERTIES OF METALS. I. FORMULATION. Walter A. Harrison (General Electric Co. Research Lab., Schenectady, N. Y.). Oct. 1962. 36p.

A method is formulated for the a priori calculation of the energy of a metal as a function of the relative positions of the ions and calculation of the scattering of electrons by defects in the structure. The method depends upon three approximations: 1. The self-consistent-field approximation; 2. The assumption that the core states are the same as in the free atom; and 3. A perturbation solution, carried to second order, of the Hamiltonian matrix based upon orthogonalized plane waves. Only the last approximation distinguishes the method from more traditional band calculations; it is regarded as appropriate for the treatment of most polyvalent metals. It is found that for a given ion density the energy of the system may be written in terms of a central-force, two-body interaction between the ions. The procedure for calculating this interaction from the Hartree-Fock field of the neutral atom is given. It is found that first-order scattering may be calculated as for a free-electron model with matrix elements given by the product of a structure factor, depending only on the ion positions, and a form factor depending only on the Hartree-Fock field of the neutral atom. The latter is a single function of the change in wavenumber and is calculated, for given ion density, from the ion field. Second-order scattering includes the effect of the periodic potential, but is distinct from Umklapp which is only first-order in the pseudopotential. The second-order calculation requires additional matrix elements which are similarly separated into factors. The form factors corresponding to these additional matrix elements may again be calculated from the ion field, but depend upon initial wavenumber as well as change in wavenumber. (auth)

30164 (AD-429007) THERMODYNAMICS OF ALLOYS—TIN-SOLUTION CALORIMETRY STUDIES OF LIQUID TIN–SILVER ALLOYS AND OF RARE-EARTH MATERIALS. Final Technical Report, December 1, 1962–November 30, 1963. J. N. Pratt and A. W. H. Morris (Birmingham. Univ., England). Contract DA-91-591-EUC-2729. 34p.

A tin-solution calorimeter was employed for the measurement of enthalpies of solution and formation of various alloys. Using a technique permitting the direct measurement of the partial quantities for each component, detailed values were obtained for the heats of solution of tin in liquid silver–tin alloys; some corresponding values for the silver partial and for the integral quantities were obtained. Studies of the heats of solution of rare earth materials in liquid tin continued. New measurements were made with ytterbium and praseodymium, and earlier values for cerium and lanthanum were recalculated in the light of more recent specific heat data. (auth)

30165 (AD-431114) MECHANICAL AND PHYSICAL PROPERTIES OF TZM MOLYBDENUM ALLOY SHEET AND OF TUNGSTEN SHEET. Fifth Quarterly Progress Report, November 1, 1963–January 31, 1964. (Southern Research Inst., Birmingham, Ala.). Feb. 28, 1964. Contract N600(19)-59530. 44p.

A program to determine preliminary design data for tungsten and TZM molybdenum sheet is reviewed. Efforts included the preparation of specimens from the tungsten sheet materials, compression and evaluations on the sheet in the recrystallized condition, additional bend evaluations on tungsten sheet in the optimum condition, tensile evaluations at room temperature and up to 2000°F on the tungsten sheets in the optimum condition, and initiation of room-temperature shear-strength determinations. The required specimen blanks for all of the evaluations on the TZM were sheared from two of the sheet thicknesses to be evaluated. Arrangements were made to fabricate fusion- and spot-welded specimens of the TZM and tungsten materials. (auth)

30166 (AD-439716) RESEARCH IN PHYSICS OF ELECTRON EMISSION AND ELECTRON TUBE TECHNOLOGY. Third Interim Report, October 16, 1963–April 15, 1964. D. E. Anderson, A. B. Laponsky, and W. T. Peria, eds. (Minnesota. Univ., Minneapolis). Contract AF33(657)-10475. 253p.

Secondary emission characteristics of Al_2O_3 and MgO dynodes are reported. Studies of thin-film tunnel current diodes and triodes and of hot electron injection into such devices are reported. Several experiments relating to BaO, (BaSr)O, and BaS cathodes are described. Interpretations of the observed low-energy electron diffraction patterns for MgO and CdF_2 are given. Further results of the surface studies of the Ge : Na and C : Na systems are presented. Results on bombardment-induced desorption of adsorbed gases and the motivation for a new experimental tube are presented. Experiments on electron emission from superconductors are described. (auth)

30167 (ASD-TDR-62-225(Pt.III)) THE ROLE OF THE GRAIN BOUNDARY IN THE DEFORMATION OF CERAMIC MATERIALS. G. T. Murray and R. A. Burn (Materials Research Corp., Orangeburg, N. Y.). Mar. 1964. Contract AF33(616)-7961. 44p.

The effect of solute additions on the deformation and fracture behavior of KCl bicrystals was investigated. This material exhibited a definite transition from brittle to ductile fracture, the brittle type being of an intergranular nature and the ductile a "necked" matrix failure. This transition temperature was about 175°C for the high purity specimens and 400°C for tilt misoriented calcium-doped (~100 ppm) bicrystals. Calcium-doped twist boundary bicrystals showed intergranular brittle fracture at temperatures as high as 600°C, which was the highest test temperature examined. It was found that wavy glide rather than the planar type was a prerequisite for ductile behavior and that the role of the solute was to suppress the onset of wavy glide, thus elevating the transition tempera-

ture. The data also showed a greater propensity for grain boundary sliding in the doped material in the tests which were conducted above the transition temperature. (auth)

30168 (ASD-TDR-62-869(Pt.II)) DEVELOPMENT OF A NICKEL-BASE ALLOY SHEET FOR HIGH-TEMPERATURE APPLICATION—MECHANICAL PROPERTIES OF INCO 713c SHEET. D. P. Duff and P. D. Watson (LTV Vought Aeronautics. Div. of Ling-Temco-Vought, Inc., Dallas). Feb. 1964. Contract AF33(657)-11160. 32p.

The objective of this program was to measure the elevated temperature tensile and stress-rupture properties of Inco 713c sheet fabricated by the basic process described in ASD-TDR-62-869 under closely controlled test conditions. Tensile tests at 1900 and 1700°F and stress-rupture tests at 1800 and 1700°F were conducted on both Inco 713c specimens and Rene-41 control specimens by an independent test agency, Metcut Research Associates of Cincinnati, Ohio. The results of the tests confirmed that Inco 713c sheet had much higher tensile and stress-rupture strengths than Rene-41 at the selected test temperatures but the ductility of the Inco 713c sheet was found to be below normally accepted values for sheet alloys. A limited program was then conducted to demonstrate the feasibility of improving the ductility by minor modifications in the rolling and heat treating procedures. (auth)

30169 (CALT-221-1) SUMMARY OF METASTABLE PHASES OBTAINED BY RAPID COOLING FROM THE MELT. Technical Report No. 26. Pol Duwez (California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials). May 1964. Contract AT(04-3)-221. 12p.

Techniques for very rapid cooling from the liquid state were developed which make possible cooling rates on the order of 2×10^6 °C/sec. Results are summarized of studies of metastable states obtained in Ag–Ge, Au–Ge, Te–Au, Te–Ag, Te–Ge, Te–Al, Te–Ga, Te–In, and Pd–Si alloys. (D.L.C.)

30170 (CONF-553-1) THE TENSILE STRESS-STRAIN OF A COMPOSITION OF ZIRCONIUM DIBORIDE–MOLYBDENUM DISILICIDE AND ITS ANOMALOUS STRAIN BEHAVIOR. F. J. Digesu and C. D. Pears (Southern Research Inst., Birmingham, Ala.). [nd]. Contract AT(40-1)-2694. 26p.

From the American Ceramic Society 66th Annual Meeting Including Symposium on Nuclear and Space Applications, Chicago, Apr. 1964.

The ultimate tensile strength and tensile modulus of an 86 zirconium diboride–13 molybdenum disilicide–1 boron nitride were investigated over the temperature range from 70°F to 3500°F. The major phase was a solid solution of zirconium diboride containing the molybdenum with a dispersion of 10% to 15% by volume silicon carbide, the boron nitride, and 5% to 15% porosity. Hot-pressed and pressed and sintered material with average densities of about 5.5 g/cc and 4.9 g/cc, respectively, were investigated employing a gas-bearing tensile system to load the specimens and provide a uniform tensile stress field to within 0.2%. Up to 2000°F, the ultimate tensile strength agreed well with MOR values; however, at about 2000°F the tensile strength of the hot pressed material decreased rapidly to only a few thousand psi while the MOR remained higher for another 1000°F. The elastic modulus, as expected, was lower than obtained by dynamic methods and also decreased sharply for the hot pressed material at about 2000°F. The presence of silica and the fairly high creep of the material during the testing time probably explain the anomaly and warn of the necessity of a close correlation between test methods and application. (auth)

30171 (KFK-204) DAS VERHALTEN VON FESTEN SPALTELEMENTEN UND PLUTONIUM IM BRENNSTOFF URANDIOXID. LITERATURUBERSICHT. (The Behavior of Fast Fission Elements and Plutonium in Uranium Dioxide Fuel. Literature Study). Dietrich H. Geithoff (Kernforschungszentrum. Institut fur Radiochemie, Karlsruhe, Germany). Dec. 1963. 29p.

A literature search on the behavior of fast fission elements and Pu in UO_2 fuel, including works published up to the middle of 1963, is presented. All important publications concerned directly with the behavior of fission products in UO_2 and mixtures of UO_2 and PuO_2 as the fuel element are included. Effects in irradiated UO_2 as this modifies the migration behavior of the fission products, were added. Rare gas behavior was not considered. All important methods for the determination of burn-up were incorporated in the study. Important tables and graphs on the composition of fission product mixtures at various irradiation and cooling times are presented in a separate chapter. (J.S.R.)

30172 (NASA-CR-54048) GENERATION OF LONG-TIME CREEP DATA ON REFRACTORY ALLOYS AT ELEVATED TEMPERATURES. Third Quarterly Report, December 26, 1963–March 26, 1964. J. C. Sawyer and E. B. Evans (Thompson Ramo Wooldridge Inc. TRW Electromechanical Div., Cleveland). Apr. 20, 1964. Contract NAS 3-2545. 41p.

Tests were carried out on the first vacuum creep unit, residual gas analyzer, optical pyrometer, and optical extensometer. Alloys whose creep properties are to be measured include W, W–25 Re, Sylvania A, TZM, TZC, ST-222, Cb-132M, and AS-30. Specifications are given for sheets and forgings of these alloys. (D.L.C.)

30173 (NBL-210(p.9-20)) THE DETERMINATION OF THE PARTICLE SIZE DISTRIBUTION OF ELEMENTAL BORON. E. C. Payne (New Brunswick Lab., AEC, N. J.).

Several methods for the determination of particle size are evaluated. Two methods are chosen as suitable for the present project, the Andreasen pipet method and the sedimentation balance method. Data representing the performance of these methods are presented and descriptions of the principles and techniques are given. (auth)

30174 (PAN-509/II) X-RAY AND NEUTRON STUDIES OF THE LINEAGE STRUCTURE IN LARGE SINGLE CRYSTALS OF ALUMINIUM. Antoni Modrzejewski and Stanisław Szarras (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Mar. 1964. 20p.

Large single crystals of aluminum grown by the Bridgman method were studied by means of neutrons and x rays. The neutron rocking curves are shown to depend for some crystals on the position of the growth axis of the crystal with reference to the neutron beam. X-ray studies have proved that the visually observed subgrains are tilted about the growth axis and tilting increases in the direction of crystal growth. The broadening of the rocking curves for vertical position of the growth axis is due to this substructure, called the lineage structure. (auth)

30175 (TID-7687(p.51-7)) ELECTRICAL PROPERTIES OF Al_2O_3 AT HIGH TEMPERATURE IN HIGH RADIATION FIELDS. G. J. Dau and M. V. Davis (Arizona. Univ., Tucson).

The effects of radiation and temperature on the resistivity of Al_2O_3 were investigated. The specimens were irradiated in an in-core vacuum chamber that allowed temperatures of over 1000°C. The results show that at room temperature the effects of a reactor specific power of 6

kw/liter decrease the resistivity by a factor of ~100. The radiation effect decreases with increasing temperature; at 600°C, the resistivity shows no change at a power level of 6 kw/liter. (D.C.W.)

30176 (TID-7687(p.117-31)) WORK FUNCTION AND DESORPTION ENERGIES AND RATES OF REFRACTORY METALS COATED WITH CESIUM. Elias P. Gyftopoulos (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics).

Some research on the theoretical correlation of the electron work function and the atom and ion desorption energies and rates for metallic surfaces coated with monatomic metallic particles is summarized. Surfaces coated with cesium are emphasized. The results obtained by the physical chemistry approach adopted are in good agreement with experimental data. (D.C.W.)

30177 (TID-7687(p.200-13)) ON THERMIONIC BEHAVIOR OF NON-METALS. S. L. Soo (Illinois. Univ., Urbana).

Thermionic emission and surface ionization of nonmetallic solids in contact with a solid are investigated theoretically. It is shown that a more positive plasma can be maintained by using a semiconductor rather than a metal. The general case of equilibrium involving emission, ionization, and space charge is treated in the first order approximation. A relation between ionization and surface charge density is obtained. Application to thermionic converters is discussed. (D.C.W.)

30178 (TID-20735) AN EVALUATION OF THE ROLE OF DEFORMATION TWINNING IN THE PLASTIC DEFORMATION OF ZIRCONIUM. Quarterly Progress Report No. 10. Robert E. Reed-Hill (Florida. Univ., Gainesville. Engineering and Industrial Experiment Station). Mar. 1964. Contract AT(38-1)-252. 33p.

The anelastic behavior of zirconium prestrained at 77°K so as to form twins in the structure has been studied. Specimens were cyclically loaded in tension to a stress approximately one third of their yield stress. A large anelastic effect was observed, which was a maximum in specimens prestrained slightly over one half percent. It has been determined by a test made on a cast iron specimen that the energy absorption characteristics of prestrained zirconium are probably very high. Evidence is presented to show that the present anelasticity is probably associated with the stress-induced movements of twin boundaries. (auth)

30179 (AI-Trans-47) THE RECOVERY OF ELECTRICAL RESISTIVITY OF COLD-WORKED TUNGSTEN. H. Schultz. Translated by Anthony Cornell (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.), from Acta Met., 12: 649-64(1964). 31p.

The recovery processes in zone-refined, cold-worked W under heat treatment were studied with respect to defect reactions. The various stages of recovery and the kinetics of each are discussed. The effects of impurities and dislocations on the annealing reactions are considered. (D.L.C.)

30180 (EURAEC-1017) STUDY OF THE FRAGILIZATION BY PLASTIC FATIGUE OF STEEL FOR REACTOR VESSELS. Quarterly Report No. 1, December 15, 1963–March 31, 1964. (Belgium. Centre National de Recherches Metallurgiques, Liege). Work Performed under United States–Euratom Joint Research and Development Program. Contract 005-63-12 TEEB. 20p. (A translation)

Facilities for fatigue tests to failure, damage and brittleness tests, and tensile tests are described, whose purpose is the analysis of effects of fatigue in the plastic range in steels. The steels studied are A302B, Soudotenax, and Ducol W. (T.F.H.)

30181 (NLCO-tr-1) COMPARATIVE INVESTIGATIONS OF SPECTROSCOPIC CARBONS. Regine Schanzen (Ringsdorff-Werke G.m.b.H., Bad Godesberg, Germany). Translated by Barbara J. Fritsche (National Lead Co. of Ohio, Cincinnati). [nd]. 56p. (Includes original, 10p.).

The purity values, the physical data, and the structural data of most commercial spectroscopic carbons have been compiled. It is concluded that the various spectroscopic carbons differ more sharply with respect to their manufacturing process, the raw materials, etc., than what is expected from the picture of their outward appearance. The structural photomicrographs produced also show these differences very clearly. It is therefore clear to what extent the spectroscopic carbons again and again influence the spectral analysis, and it is understandable that the purity alone is not decisive as to the quality and suitability of a spectral carbon for a certain analytical procedure. Next to the purity, the physical data and the structural data are considered, and it is concluded that it is the task of the manufacturer of spectroscopic carbons to observe the physical data and the structural values accurately at any given time. It is clearly shown that it is generally not possible for the manufacturer to change something at any time in the various data without expecting an influence on the spectral analysis. (auth)

30182 INFLUENCE OF STRESS HISTORY ON TIME-DEPENDENT SPALL IN METALS. B. M. Butcher, L. M. Barker, D. E. Munson, and C. D. Lundergan (Sandia Corp., Albuquerque, N. Mex.). AIAA (Am. Inst. Aeron. Astronaut.) J., 2: 977-90(June 1964). (TID-18550; SC-DC-3157)

The complete description of the stress history at the plane of spall is necessary to determine the criteria for fracture. The stress history of a material must be defined by a constitutive equation of state that describes the dynamic loading and unloading behavior. Time-dependent spall was observed in experiments in which the stress pulse approximates a square wave. Previous single-valued spall stresses obtained with triangular pulses are not inconsistent with the time-dependent values. The fracture mechanism, therefore, must be one that is not instantaneous and may depend upon the rate of crack initiation or propagation. (auth)

30183 THE EFFECT OF HYDROSTATIC PRESSURE ON THE DUCTILE-BRITTLE TRANSITION IN MOLYBDENUM. J. R. Galli and P. Gibbs (Univ. of Utah, Salt Lake City). Acta Met., 12: 775-8(July 1964).

The ductile–brittle transition temperature for bend specimens of recrystallized powder metallurgy molybdenum was shown to be lowered from 50 to 2°C by the application of a hydrostatic pressure of ~20,000 psi (~1.4 kbar). The pressure medium was kerosene. The samples were obtained from 0.020 in. dia wire, which was stated to be 99.95% pure and after recrystallization had an average grain diameter of $^1/_{10}$ mm. It was shown within experimental error that an applied hydrostatic pressure of 20,000 psi results in an increase in the fracture stress by this same amount and thus it was concluded that the rate controlling mechanism of fracture is governed by the tensile component of the applied stress and is independent of a corresponding change in the maximum shear stress of 10,000 psi. It is argued that any critical shear stress that may be important to the fracture process must have a value at or below the value of the maximum shear stress at the transition temperature corresponding to atmospheric pressure.

It was estimated that at least for some cases this value is as low as 37,500 psi. (auth)

30184 A FIELD ION MICROSCOPE STUDY OF ATOMIC CONFIGURATION AT GRAIN BOUNDARIES. D. G. Brandon (Univ. of Cambridge, Eng.), B. Ralph, S. Ranganathan, and M. S. Wald. Acta Met., 12: 813-21 (July 1964).

The structure of grain boundaries can be studied in atomic detail with the field ion microscope. A number of grain boundaries in tungsten and tungsten–rhenium alloys were examined, and the information from these studies was collected. The distribution of strain energy in the region of a low angle boundary leads to preferential field evaporation of material from this region. The field ion microscope proved more useful for elucidating the atomic structure at high angle grain boundaries. The width of high angle boundaries was observed to be very narrow (approximately 2 atom diameters) and such a boundary showed regions of good and bad fit. These observations were correlated with a model for high angle boundaries, developed from coincidence site lattice theory. For two grains related by particular misorientations about specific axes, high density coincidence site lattices existed, and these special relationships were tabulated. It is shown that deviations from these relationships can be accommodated by the introduction of a dislocation sub-boundary. The effect of the orientation of the boundary plane is given and it is shown that good fit regions are developed where the boundary follows the most densely packed planes in the coincidence lattice. A stepped structure is generated where the boundary runs at an angle to these planes. Segregation effects at grain boundaries are illustrated and it is shown that the processes giving rise to an image from a finite concentration solid solution make it difficult to determine the atomic structure of a grain boundary in such a material. (auth)

30185 ELECTRICAL PROPERTIES OF THIN FILMS. E. H. Rhoderick (Manchester Coll. of Science and Tech., Eng.). Brit. J. Appl. Phys., 15: 613-23(June 1964).

Several parameters with the dimensions of length, such as the mean free path of conduction electrons in a metal, occur in theories of the electrical properties of solids. A change in properties would therefore be expected if the dimensions of a solid become comparable with one or more of these parameters, so that a difference between the electrical behavior of thin films and that of bulk material would be predicted. Examples of such phenomena, chosen from the fields of normal conductors, superconductors, and insulators, are given, along with some brief mention of their importance in technology. (auth)

30186 BITTER FIGURE OBSERVATIONS ON GADOLINIUM. L. F. Bates and Sylvia Spivey (Univ. of Nottingham, Eng.). Brit. J. Appl. Phys., 15: 705-7(June 1964).

An account is given of domain patterns observed on surfaces of crystals of gadolinium using a low temperature colloid technique; the observed structures are similar to those for uniaxial materials. (auth)

30187 INVESTIGATION OF THE SYSTEM CHROMIUM–NIOBIUM–MOLYBDENUM. V. M. Svechnikov and G. F. Kobzenko (Inst. of Physics of Metals, Academy of Sciences, Ukrainian SSR). Dopovidi Akad. Nauk Ukr. RSR, No. 4, 492-8(1964). (In Ukrainian)

Differential thermal and micro- and roentgenostructural analyses were employed to investigate the system Cr–Nb–Mo over a temperature range of 1000 to 2000°C. The existence of four one-, six two- and three three-phase regions was established, and the boundaries of their occurrence were determined. Three-phase eutectic ($L \rightleftharpoons \epsilon + \alpha$), eutectoid due to polymorphism in $NbCr_2$ ($\epsilon \rightleftharpoons \alpha + \beta$), and peritectoid ($\epsilon + \alpha \rightleftharpoons \beta$) equilibria are realized in the system. Decomposition (of the lamination type) of the α-solid solution on a Cr, Nb, Mo base on α_1 and α_2 is observed. The formation of a three-phase region with equilibrium $\alpha_1 = \alpha_2 + \beta$ is connected with the appearance of a lamination region. (auth)

30188 MELTING DIAGRAM OF THE SYSTEM $MgO–Al_2O_3–ZrO_2$. A. S. Berezhnoi and R. A. Kordyuk (Inst. of High-Temperature Materials, Academy of Sciences, Ukrainian SSR). Dopovidi Akad. Nauk Ukr. RSR, No. 4, 506-8(1964). (In Ukrainian)

On the basis of new experimental data the melting diagram of the system $MgO–Al_2O_3–ZrO_2$ was constructed, and the location of the boundary lines was tentatively determined. It was found that ZrO_2 and $MgAl_2O_4$ form a simple pseudobinary system with eutectic, melting at 1860°C, and containing about 52% by weight of ZrO_2. Two ternary eutectics in this system are formed by the following solid phases (and by the melt) with the following melting points and approximate composition (% by weight): $Al_2O_3–ZrO_2–MgAl_2O_4$; 1830°C; 7% MgO, 43% Al_2O_3, and 50% ZrO_2; $MgO–ZrO_2–MgAl_2O_4$; 1840°C; 20% MgO, 20% Al_2O_3, and 60% ZrO_2. The solid solutions contain not more than several per cent of the third oxide. In the investigated system the relative value of the region of compositions containing not more than 10% of the melt at 2000°C is about 7.5%. (auth)

30189 PREPARATION AND PROPERTIES OF THIN FILMS OF MOLYBDENUM OXIDE. I. Ames and L. V. Gregor (International Business Machines Corp., Yorktown Heights, N. Y.). Electrochem. Technol., 2: 97-101(Mar.-Apr. 1964).

Thin films of molybdenum oxide were prepared by sublimation from a hot Mo tube through which oxygen is passed and by direct thermal evaporation of solid MoO_3 pellets. The film thicknesses ranged from 30 to 10,000 Å and test capacitors were made with such films as the dielectric. The physical properties of the films were determined. Indications were that they were semi-insulators composed of partially reduced MoO_3, having resistivities ranging from 10^6 to 10^8 ohm-cm. (auth)

30190 RECENT DEVELOPMENTS IN COATINGS FOR REFRACTORY MATERIALS. C. A. Krier and J. M. Blocher, Jr. (Battelle Memorial Inst., Columbus, Ohio). Electrochem. Technol., 1: 137-48(May-June 1963).

Reliable protection from oxidation of useful hardware made of tungsten, tantalum, molybdenum, niobium, and vanadium alloys is a major materials and process problem on which progress is being made. Chemical vapor-deposition and paint-diffusion techniques are being used predominantly to prepare most of the coatings, which are based on silicides and aluminides. Coatings for molybdenum and niobium alloys are at the advanced development stage where simple-to-complex prototype hardware is being evaluated. Promising coatings exist at the laboratory research level for tantalum, tungsten, and vanadium alloys. Disappointments were experienced in trying to extrapolate single-laboratory test data on coupons to reliable performance of functional hardware. Coated molybdenum and niobium alloys are expected to be used in some space-vehicle applications. (auth)

30191 THERMAL ETCHING AS A MEAN TO EVIDENCE GRAIN-BOUNDARIES IN HIGH-DENSITY UO_2. G. C. Grappiolo (FIAT, Turin). Energia Nucl. (Milan), 11: 273(May 1964).

The use of thermal etching as a means of indicating the grain boundaries without disturbing the structure in high-density sintered uranium oxide is recommended. The etching process is described, and a sample micrograph is given. (M.J.T.)

30192 RESEARCH ON ZIRCONIUM ALLOYS WHICH ARE COMPATIBLE WITH CARBON DIOXIDE UNDER PRESSURE UP TO 600°C. P. Baqué, R. Dominget, and J. Bossard (CEN, Saclay, France). Energie Nucl., 6: No. 2, 89-106(Mar.-Apr. 1964). (In French)

Zirconium has a small neutron capture cross section and a high melting point; it can be used, especially, as a canning material for fuel elements for reactors. However, a preliminary study of several grades of zirconium has shown that the metal is strongly oxidized in this gas as low as 500°C. Research on binary and ternary alloys has led to several interesting compounds: 1, 1.6, and 2.5% copper, 2% vanadium and 0.05 and 0.5% calcium, Ternary alloys of copper–molybdenum and phosphorus–copper are less oxidizable, and, in particular to not exhibit the "breakaway" phenomenon, even after being exposed to 600°C for a long while. (auth)

30193 CREEP, STRENGTH, EXPANSION, AND ELASTIC MODULI OF SINTERED BeO AS A FUNCTION OF GRAIN SIZE, POROSITY, AND GRAIN ORIENTATION. R. E. Fryxell and B. A. Chandler (General Electric Co., Cincinnati). J. Am. Ceram. Soc., 47: 283-91(June 21, 1964).

Physical properties are presented for extruded and sintered BeO from 25 to 1400°C as a function of porosity (0 to 15%), grain size (5 to 100μ), and grain orientation (random to 80% preferred). The elastic constants and linear thermal expansion are sensitive to the degree of preferred grain orientation. Measurements on polycrystalline specimens permitted calculation of the anisotropy in single crystals of BeO for these properties. Modulus-of-rupture data are treated in terms of the Knudsen equation, and compressive creep data were used to estimate the diffusion coefficient controlling strain rate at 1200°C. (auth)

30194 DISCUSSION OF "MELTING BEHAVIOR IN THE SYSTEM UO_2–PuO_2" BY T. D. CHIKALLA. Leonard B. Gross. J. Am. Ceram. Soc., 47: 308-9(June 21, 1964).

Values of the vapor-pressure ratios for PuO_2 and UO_2 over the temperature range 1300 to 2300°C given by Chikalla are found to disagree with values obtained by calculations from known vapor pressures. An error in the sources for Chikalla's work is acknowledged. (M.J.T.)

30195 THERMAL EXPANSION OF CERTAIN GROUP IV AND GROUP V CARBIDES AT HIGH TEMPERATURES. C. R. Houska. J. Am. Ceram. Soc., 47: 310-11(June 21, 1964).

An investigation was carried out to extend the temperature range and increase the precision of thermal-expansion data for refractory carbides of group IV and V transition metals. Thermal-expansion data for TiC, ZrC, HfC, NbC, and TaC, all having the NaCl structure and melting above 3000°C, are reported for temperatures from 25 to 2080°C. (M.J.T.)

30196 RESISTANCE MINIMA AND MAXIMA IN DILUTE ALLOYS OF RARE-EARTH METALS. Tadashi Sugawara, Ryukichi Soga, and Ikuyo Yamase (Tokyo Univ.). J. Phys. Soc. Japan, 19: 780(May 1964).

The resistivity of Y–Ce (1.0 and 2.0% Ce) and Ag–Gd (0.3 and 0.5% Gd) alloys was measured as a function of temperature from 1.5 to 25°K. A minimum was observed in the curve for Y–Ce; and a maximum was observed for Ag–Gd, attributed to the onset of a magnetic ordering. (D.C.W.)

30197 NEW RESULTS IN THE DEVELOPMENT OF FUEL ELEMENTS WITH PLUTONIUM. K. Diebner. Kerntechnik, 6: 261(June 1964). (In German)

Properties of plutonium for use in fuel elements are described. Use of PuO_2–UO_2 systems in fast reactors is discussed. (M.C.G.)

30198 INVESTIGATION OF Fe–Rh ALLOYS BY MEANS OF THE MÖSSBAUER EFFECT. László Cser, István Dézsi, and Lajos Keszthelyi. Magy. Tud. Akad. Kozp. Fiz. Kut. Int. Kozlemen., 12: 119-24(1964). (In Hungarian)

The antiferromagnetic to ferromagnetic transition in 50% Fe–Rh alloy was studied by the Mössbauer effect. In the transition process the internal field strength changed by 6 ± 2 kG, the line width increased by ~20%, the intensity decreased and the isomer shift suddenly changed. The 54% γ phase did not show any magnetic properties in the temperature range of –170 to +250°C. (auth)

30199 EVALUATING COATED PARTICLES OF NUCLEAR FUEL. Robert W. McClung, E. Sloan Bomar, and Robert J. Gray (Oak Ridge National Lab., Tenn.). Metal Progr., 86: No. 1, 90-3(July 1964).

Metallographic and radiographic methods were combined and modified to evaluate coated fuel particles. Methods of rating structure, radiography exposure requirements, and microscopic examination of radiographs are discussed. Advantages and potentials of this procedure are outlined. (M.C.G.)

30200 ELECTRON SPINWAVE SCATTERING IN RARE EARTH METALS. B. Luethi and F. Grueneisen (International Business Machines Corp., Zurich). Phys. Letters, 10: 161-2(June 1, 1964).

The variation of the electric conductivity of Gd, Dy, and Lu wires was measured in magnetic fields up to 200 kgauss. The observations for Gd can be understood in terms of a strong exchange scattering contribution to the electrical resistance in zero field. A lower limit for the zero-field value of the spinwave resistance was obtained, and its magnetic field and temperature dependence was examined. The observations on Dy and Lu are briefly discussed. (D.C.W.)

30201 ATOMIC HEATS OF CESIUM, RUBIDIUM, AND LITHIUM BETWEEN 0.35 AND 2°K. B. D. Martin, D. A. Zych, and C. V. Heer (Ohio State Univ., Columbus). Phys. Rev., 135: A671-9(Aug. 3, 1964).

The electronic and lattice contributions to the atomic heat of lithium, rubidium, and cesium were determined from heat capacity measurements on large high-purity samples between 0.35 and 2°K. The linear contribution to the heat capacity yields a value for γ of 1.71 for Li, 4.07 for Rb, and 6.29 for Cs in mJ/mole-(°K)^2. Interpreting this linear contribution to the heat capacity in terms of the density of single-excitation states at the Fermi level, a thermal effective mass $C_{el}/C_0 = \gamma/\gamma_0 = m/m_0$ is obtained. The value is $m/m_0 = 2.31$ for Li, 2.14 for Rb, and 2.82 for Cs. These values for the thermal effective mass suggest considerable anisotropy for the Fermi surface and are compared with the band calculations of F. S. Ham, and a calculation by Silverstein which combines the results of the band calculation with electron-electron interaction. The value for Li is in good agreement with that of Martin, but the effective mass for rubidium and cesium are considerably larger than the values of 1.26 and 1.43 obtained by Lien and Phillips. The lattice contribution to the very low-

temperature heat capacity is described by a value of Θ_0 = 58.7 for Rb and Θ_0 = 40.6 for Cs. The dependence of Θ on temperature is given and the values at 2°K are in good agreement with the data of Lien and Phillips and the data of McCollum and Silsbee. (auth)

30202 DOMAIN PATTERNS DUE TO INTERSTITIAL IMPURITIES IN TANTALUM. L. Stals and J. Van Landuyt (SCK-CEN, Mol, Belg.). Phys. Status Solidi, 5: K1-3 (1964).

Thin foils of high-purity tantalum were annealed for 1 hr at 1500°C in a vacuum of 10^{-4} Torr and then electropolished. Thin transparent sections were studied. The same internal oxidation features (domain patterns) as found in niobium were also observed in tantalum. The domains presumably resulted from the preferential occupation of one set of interstices by impurities rather than another in a given domain. (M.C.G.)

30203 MAGNETIC INVESTIGATIONS OF RELAXATION PHENOMENA IN Fe–Si–C ALLOYS. J. W. Moroń. Phys. Status Solidi, 5: K77-9(1964).

Magnetic losses and their dependence on temperature and disaccommodation curves were measured for Fe–C–Si samples. Between –50 and +100°C two disaccommodation regions were found. The loss measurements showed that these two regions are combined with other relaxation processes. It was also found that the same diffusion processes occur in Fe–Si–N systems as in Fe–Si–N systems. (M.C.G.)

30204 MEASUREMENT OF THE GRAIN-BOUNDARY DIFFUSION OF NICKEL-63 IN NICKEL AND γ-IRON. W. Lange, A. Haessner, and G. Mischer (Technische Universität, Dresden and Institut für Metallkunde und Materialprufung der Bergakademie, Freiberg i. B.). Phys. Status Solidi, 5: 63-71(1964). (In German)

The grain-boundary diffusion of ^{63}Ni in nickel and γ-iron, was investigated by a residual-activity method in the temperature regions 850 to 1100°C and 940 to 1130°C. The temperature dependence of the diffusion is described by an Arrhenius equation. For grain-boundary self-diffusion in Ni, agreement was obtained with the results of Upthegrove and Sinnott for tilt boundaries of bicrystals, if the mean value taken over all grain boundaries is used. In connection with results of Lücke and Gerzriken the possibility of a vacancy-diffusion mechanism for large-angle-boundaries is discussed. (auth)

30205 REST-RESISTANCE BEHAVIOR, DIAMETER EFFECT, AND CURRENT DEPENDENCE OF THE RESISTANCE RATIO OF ZONE-MELTED TUNGSTEN AT LOW TEMPERATURES. K.-H. Berthel (Institut für Angewandte Physik der Reinststoffe, Dresden). Phys. Status Solidi, 5: 159-68(1964). (In German)

The resistance ratio r(T) = R(T)/R(273) of electron-beam zone-refined tungsten single crystals was studied over the temperature range from 1.4 to 27°K. The extrapolated residual resistance ratios r_0 = R(0)/R(273) ranged from 3 to 65 × 10^{-6}. The results are compared with Matthiessen's rule. Throughout the whole temperature range, the resistivity of the samples was found to be increased by the magnetic field of the sample current. Between 14 and 20°K, the dependence of the resistivity ratio on the diameter of the samples was measured, and the product of the mean free path λ and the bulk resistance ratio r_∞ ($r_\infty \cdot \lambda$ = 3.8 × 10^{-6} cm) was calculated in terms of the experimental results. (auth)

30206 BRADBURN-FÜRTH EQUATION OF STATE AND THERMAL EXPANSION OF FACE-CENTERED METALS. H. D. Pandey and B. Dayal (Banaras Hindu Univ., India). Phys. Status Solidi, 5: 273-7(1964).

The relative changes of lattice constants due to thermal expansion were calculated for seven metals, Al, Ag, Cu, Au, Ni, Pt, and Pd, by means of the Bradburn-Fürth equation of state. The theoretical results at high temperatures, where this equation of state is valid, were found to be in very good agreement with experimental data. (auth)

30207 THE SPECIFIC ELECTRIC RESISTANCE OF ELECTRON-BEAM-ZONE-MELTED TUNGSTEN BETWEEN 1.4 AND 27°K. K.-H. Berthel (Institut für Angewandte Physik der Reinststoffe, Dresden). Phys. Status Solidi, 5: 399-406(1964). (In German)

The ideal resistance ratios of tungsten single crystals were studied over the temperature range of liquid helium, hydrogen, and neon. The crystals had residual-resistance ratios $R_0/R(273)$ between 3 and 67 × 10^{-6}. Between 1.4 and 4.2°K the temperature dependence of the ideal resistance ratio was influenced considerably by the sample diameter. Within this range, for the purest sample, the mean free path of the current carriers was found to be larger than the sample diameter. Above 14°K, all samples had the same ideal resistance ratio, and between 19 and 27°K, this ratio was represented very well by the Bloch-Grüneisen formula $r_i \sim T^5$. (auth)

30208 INVESTIGATION OF THE CONTACT REACTION OF METAL-LIKE CARBIDES WITH GRAPHITE AT HIGH TEMPERATURES IN A VACUUM. A. L. Burykina and T. M. Evtushok (Inst. of Solids, Academy of Sciences, Ukrainian SSR). Poroshkovaya Met., Akad. Nauk Ukr. SSR, No. 2, 19-21(Mar.-Apr. 1964). (In Russian)

Reactions of titanium, zirconium, hafnium, niobium, tantalum, molybdenum, and tungsten carbides with graphite were studied in the temperature range of 1800 to 2200°C for a contact time of up to 10 hours. The following observations were made: (1) the weight of carbide samples after annealing in a graphite covering was maintained to an accuracy of several hundredths of a percent; (2) no traces of the reaction were revealed in the metallographic investigation on the graphite-carbide contact boundary; (3) the microhardness of the carbide samples in graphite after contact near the boundary was maintained within the limits of measurement error; and (4) the results of the chemical analysis confirm the absence of a graphite reaction with any of the carbides. This last observation agrees with bibliographic data, where the melting temperature of the eutectics of pseudobinary systems has been established: 3080 ±50°C for TiC–C, 2920 ±50°C for ZrC–C, 3150 ±50°C for NbC–C, 3310 ±50°C for TaC–C, and 3250 ±50°C for HfC–C. (auth)

30209 HIGH TEMPERATURE DIFFERENTIAL RESISTANCE BRIDGE CALORIMETER. T. K. Engel, K. C. Jordan, G. W. Otto, and D. M. Scott (Monsanto Research Corp., Miamisburg, Ohio). Rev. Sci. Instr., 35: 875-80 (July 1964).

The construction and transient operation of a differential resistance-bridge calorimeter that successfully operated up to 700°C are described. Heat capacity and latent heat of transformation are measured in the calorimeter by absolute methods. The heat capacity of nickel and the heats of fusion of bismuth and cadmium are presented and agree well with previously published data. (auth)

30210 DEPENDENCE OF THE ELECTRICAL RESISTIVITY OF GRAPHITE ON THE MAGNETIC FIELD. Yu. A. Pospelov and V. V. Kechin (Inst. of High-Pressure Physics, Moscow). Soviet Phys. Solid State (English

Transl.), 5: 2622-6(June 1964). Translated from Fiz. Tverd. Tela, 5: 3574-9(Dec. 1963).

A formula for the electrical resistivity of graphite in an arbitrary magnetic field is derived, based on solution of the Boltzmann equation in the relaxation-time approximation. This formula is compared with the experimental dependence for monocrystalline graphite samples in the temperature region 290–450°K in fields up to 5 kgauss and at hydrostatic pressures up to 9000 atm. (auth)

30211 SILICON EFFECT ON MAGNESIUM–LITHIUM BASE ALLOYS. A. Saia and R. E. Edelman (Frankford Arsenal, Philadelphia). Trans. Am. Foundrymen's Soc., 70: 6p. (1962).

Silicon additions of 0.25 to 1.50% to certain Mg–Li base alloys were found to be beneficial in decreasing the tendency of these alloys to overage. Accelerated aging tests showed that a solution-treated alloy having the nominal composition of Mg–14Li–1Al–1Zn–3Ag had tensile properties of 22,000 psi ultimate strength and 12% elongation after 24 hr at 225°F. The addition of 0.5% silicon had the effect of raising the U.T.S. to 28,600 psi, without changing the percentage elongation, after the same treatment. The mechanism by which this effect is produced was not established. However, it was observed that the silicon-containing alloys had smaller grain size than the control composition. (auth)

30212 ON THE DUCTILITY OF ELECTRON BEAM MELTED MOLYBDENUM. Kazuo Tsuya and Noriyoshi Aritomi. Trans. Natl. Res. Inst. Metals (Tokyo), 5: 18-22 (1963).

The ductility of molybdenum, processed to sheets from electron beam melted ingots, was compared with that of commercial sintered molybdenum sheets. Molybdenum powder with 0.06 percent carbon was electron-beam melted in a water-cooled copper boat, which was moved horizontally. The ingots (8 × 15 × 200 mm) were hammered and rolled to the sheets 1 mm and 0.3 mm in thickness. The specimens, cut from electron beam melted molybdenum sheets and sintered ones, were fully recrystallized at 1300°C. The bend angles and the tensile properties of these specimens, were determined at temperatures ranging from –100 to 25°C and from –90 to 150°C, respectively. The results obtained are summarized as follows: A fully recrystallized structure was observed at 1100°C in sintered molybdenum, while electron-beam melted molybdenum recrystallized completely at 1000°C with coarser recrystallized grains. In tensile tests at temperatures ranging from –50 to 25°C, the amount of elongation that occurred after necking was larger in electron-beam melted specimens than in sintered specimens. The ductility transition temperature below which complete brittle fracture occurred was about 30°C lower in electron-beam melted molybdenum than in sintered molybdenum. (auth)

30213 RARE EARTH BERYLLIDES. M. M. Matyushenko, V. M. Karev, and O. P. Svinarenko (Inst. of Physics and Tech., Khar'kov). Ukr. Fiz. Zh., 8: 1266-7 (1963). (In Ukrainian)

Physico-chemical properties of rare metal beryllides (BeO) are analyzed. Lattice parameters are given for 15 of the beryllides. (R.V.J.)

30214 MASS SPECTROMETRIC INVESTIGATION OF DEGASIFICATION OF MOLYBDENUM, TUNGSTEN AND NIOBIUM ON HEATING THEM IN A VACUUM. L. M. Ryabachykov. Ukr. Fiz. Zh., 9: 293-302(Mar. 1964). (In Ukrainian)

The basic components of the gas evolved from molybdenum, tungsten, and niobium on heating in a vacuum above 1000°C are hydrogen and carbon monoxide. The rates of degasation at various temperatures were determined by the change in pressure in the degasation chamber recorded by a mass spectrometer and the diffusion constant was computed. The diffusion constants of hydrogen were found to be in molybdenum, D = 0.158 e $-22{,}200/RT$, in tungsten, D = 0.081 e $-19{,}800/RT$, and in niobium, D = 0.056 e $-19{,}200/RT$. The rate of removal of carbon monoxide considerably exceeds that of carbon and oxygen border diffusion in the given metals. At temperatures above 1800°C, evolution of oxygen from niobium was found. The diffusion constants of oxygen in niobium at 2145 to 2350°C were determined by the rate of degasation. (auth)

30215 ANTIFERROMAGNETISM AND PLASTICITY OF CHROMIUM AND SOME OF ITS ALLOYS WITH TRANSITION METALS. O. K. Butylenko and V. N. Gridnev. Ukr. Fiz. Zh., 9: 325-33(Mar. 1964). (In Ukrainian)

The effect of the alloying of chromium in solid solutions with elements of the third large period from Lu to Os, as well as Ru, on the position of the Neiel point and the magnitude of the effects in it was studied by measuring the specific electric resistance, the thermal emf, and the thermal expansion. It is shown that Lu, Hf, Ta, and W lower the Neiel point, without having any substantial effect on the magnitude of the effects as compared with the effects on pure chromium. Re, Os, and Ru extend the region of transformation and raise the Neiel point. Comparing the nature of the changes in the properties at the Neiel point with the transition temperature of the alloys does not permit setting up a correlation between antiferromagnetism and the plasticity of chromium and its alloys. (auth)

30216 THE STRUCTURE OF AB COMPOUNDS OF HEAVY ALKALI METALS WITH TIN AND LEAD. I. F. Hewaidy, E. Busmann, and W. Klemm (Universität, Munster, Ger.). Z. Anorg. Allgem. Chem., 328: 283-93(Apr. 1964). (In German)

After establishing the existence of the phase KSn in the system K–Sn by thermal analysis the crystal structure of this compound was determined. Isotypism with NaPb was shown by rotation and Weissenberg diagrams. The tetragonal lattice parameters are a = 11.42 and c = 18.57 Å; the Sn–Sn distances in the Sn_4-tetraeders are 2.98 Å. The structures of RbSn, CsSn, KPb, RbPb, and CsPb were determined by powder patterns and found to be the same as that of NaPb. The distribution of the different structures for the AB compounds of the group IV elements with alkali metals was studied. Silicides and germanides were found to crystallize in the KGe-type with the exception of NaSi and NaGe, and stannides and plumbides in the NaPb-type. Close interactions between the neighboring B_4-tetraeders apparently determined the structures of stannides and plumbides. The exceptional structures of NaSi and NaGe appeared to be caused by the ratio of the radii r_{A^+}/r_{B^-}. (auth)

30217 PREPARATION AND SUPERCONDUCTIVITY PROPERTIES OF TWO-COMPONENT DIFFUSION LAYERS ON NIOBIUM AND VANADIUM. II. CRITICAL CURRENT STRENGTHS OF TWO-COMPONENT DIFFUSION LAYERS ON NIOBIUM IN TRANSVERSAL MAGNETIC FIELDS TO 90 kOe. C. Mueller and E. Saur (Universität, Giessen, Ger.). Z. Physik, 179: 111-15(1964). (In German)

Curves of critical current strength of two-component diffusion layers on niobium with tin as a component in transversal magnetic fields to 90 kOe are given. In the region of high field strength the curves of critical field

strength for various elements (Al, In, Rb, and Bi) as the second component lay beneath the curves of pure Nb–Sn diffusion layers for corresponding preparation conditions. (tr-auth)

30218 INTRODUCTORY LECTURES ON SEMICONDUCTORS. E. Germagnoli (Laboratori CISE, Milan and Istituto di Fisica del Politecnico, Milan). p.318-32 of "Radiation Damage in Solids." New York, Academic Press, 1962.

The properties of germanium and silicon, particularly the effect of impurities and lattice disorders, are discussed using both theoretical and experimental observations. (D.C.W.)

30219 DISPLACEMENT THRESHOLDS IN SEMICONDUCTORS. R. Baeuerlein (Siemens-Schuckertwerke AG, Erlangen, Ger.). p.358-74 of "Radiation Damage in Solids." New York, Academic Press, 1962.

The status of displacement threshold determination in semiconductors is summarized. Methods for threshold determination and experimental determinations of displacement energies in Ge, Si, III-V compounds, and CdS are considered, together with the relation between displacement and bond energy in diamond and zinc-blend lattices. The displacement energies of the elemental semiconductors of Group IV in the periodic table are estimated from the known bond energy and are compared with measured values. (D.C.W.)

30220 QUENCHED-IN VACANCIES AND LOW-TEMPERATURE DIFFUSION IN Al-RICH ALLOYS. T. Federighi (Istituto Sperimentale Metalli Leggeri, Novara, Italy). p.801-8 of "Radiation Damage in Solids." New York, Academic Press, 1962.

Some experimental evidence supporting the role of quenched-in thermal vacancies in controlling the kinetics of the clustering process is reviewed. A model for the kinetics of pre-precipitation (zone formation) is summarized. (D.C.W.)

30221 OBSERVATION OF ROTATION OF CRYSTALLITES IN HAFNIUM CRYSTAL. P. J. Ouseph (Univ. of Louisville, Ky.) and F. L. Canavan. p.264-5 of "Perturbed Angular Correlations." Amsterdam, North-Holland Publishing Co., 1964.

The results of angular correlation measurements using Hf single crystal sources prepared by zone refinement and drawing rods from melts are presented. The results for the latter crystal indicate a continuous change of the field direction at a number of nuclei in the crystal, possible only if a few crystallites move inside the crystal. (D.C.W.)

30222 STUDY OF THE PORTEVIN-LE CHATELIER PHENOMENON IN COMMERCIALLY PURE BERYLLIUM. Michel Weisz, José Mallen, and Yves Adda (CEN, Saclay, France). p.19-26 of "6e Colloque de Métallurgie. Relations Entre Défauts a l'Échelle Atomique et Propriétés Macroscopiques." Gif-sur-Yvette, France, Centre d'Études Nucléaires de Saclay and Paris, Presses Universitaires de France, 1962. (In French)

The Portevin-Le Chatelier phenomenon in commercially pure beryllium was studied in the temperature range between 300 and 600°C. The results showed that the impurity that causes this phenomenon is probably iron and the resulting hardening of the matrix is related to the brittleness of commercially pure beryllium. This indicated a simple mechanism of the embrittlement of beryllium and practical ways of avoiding it. However, an analysis of the theory of the Portevin-Le Chatelier phenomenon seemed to prove that the concentration of vacancies due to cold working, is more important in beryllium than can be obtained from classical relations. (auth)

30223 LOCKING BY A DISLOCATION REACTION OF TWINS IN α URANIUM. J. Leteurtre (CEN, Saclay, France). p.27-34 of "6e Colloque de Métallurgie. Relations Entre Défauts a l'Échelle Atomique et Propriétés Macroscopiques." Gif-sur-Yvette, France, Centre d'Études Nucléaires de Saclay and Paris, Presses Universitaires de France, 1962. (In French)

The formation of Frank's dislocations in twin planes of α-uranium, following the reaction: twin dislocations + perfect dislocation → Frank's dislocation, was observed. These sessile dislocations, fixed at the intersection of the twin plane and slip plane, impeded twin development. (auth)

30224 EFFECTS OF IRON TRACES ON THE CRYSTALLIZATION OF URANIUM MONOCARBIDE. O. Toft Sorensen and A. Accary (CEN, Saclay, France). p.75-90 of "6e Colloque de Métallurgie. Relations Entre Défauts a l'Échelle Atomique et Propriétés Macroscopiques." Gif-sur-Yvette, France, Centre d'Études Nucléaires de Saclay and Paris, Presses Universitaires de France, 1962. (In French)

It is shown that in the range of percentages under 1000 ppm, an addition of iron has an important effect on the grain growth of uranium monocarbide, when submitted to heat treatment at a temperature between 1600 and 2000°C. The velocity of grain growth was found to be the minimum for an iron content of 150 ppm. The experimental facts are explained by a suggested decrease of mobility of dislocations due to impurities and by the anchoring of grain boundaries by segregated impurities. (auth)

30225 ASPECTS AND CONFIGURATIONS OF DISLOCATIONS RESULTING FROM THE DEFORMATION AND THEIR RELATION WITH MECHANICAL PROPERTIES OF CUBIC CENTERED METALS. A. Fourdeux and A. Berghezan (European Research Associates, Brussels). p.91-118 of "6e Colloque de Métallurgie. Relations Entre Défauts a l'Échelle Atomique et Propriétés Macroscopiques." Gif-sur-Yvette, France, Centre d'Études Nucléaires de Saclay and Paris, Presses Universitaires de France, 1962. (In French)

The mechanism of plastic deformation of Nb was studied on an atomic scale by transmission electron microscopy by stretching the samples both inside and outside the microscope to different points along the stress-strain curve. The dislocation patterns and interactions that developed at each stage of the deformation process were thus directly observed and recorded. It was found that cross-slip is the main deformation mechanism that prevents any pile-up dislocations against any barrier (e.g., grain boundaries). For the same reason the dislocations bypassed very easily the precipitate particles instead of piling up behind them. This explained the low work-hardening rate of this metal and showed why it should be exceptionally ductile. (auth)

30226 EMBRITTLEMENT OF ZIRCONIUM BY INTERSTITIAL OXYGEN. P. Lehr and J. Debuigne (CNRS, Vitry-sur-Seine, France). p.139-50 of "6e Colloque de Métallurgie. Relations Entre Défauts a l'Échelle Atomique et Propriétés Macroscopiques." Gif-sur-Yvette, France, Centre d'Études Nucléaires de Saclay and Paris, Presses Universitaires de France, 1962. (In French)

The properties of zirconium–oxygen solid solutions were studied. The presence of interstitial oxygen atoms disturbed deeply the mechanical properties of the metal. Deformation tests in compression or tension showed that the Zr–O systems studied are lacking of any plasticity. The deformation mechanisms such as slip and twinning are fully inhibited. Fractographies revealed the typical features of brittle fracture. This brittleness resulted from the build-

ing of very stable bounds between zirconium and oxygen atoms in the crystal lattice. (auth)

30227 A NEW HIGH FIELD SUPERCONDUCTOR ALLOY. W. T. Reynolds, M. S. Walker, and C. K. Jones (Westinghouse Electric Corp., Pittsburgh). 20p. (CONF-524-11)

From American Institute of Mining, Metallurgical and Petroleum Engineers Annual Meeting, New York, Feb. 1964.

Niobium–titanium alloys possess several characteristics which are attractive for superconductor applications. Critical temperature is above 9.0°K in alloys containing 0 to 40 weight percent titanium. Upper critical field at 4.2°K lies between 60 and 125 kilogauss in alloys with 15 to 75 weight percent titanium. Useful critical supercurrent density has been obtained. Nb–40% Ti alloy wire carries not only significantly greater current in a coil at a given field than alloys of the Nb–Zr system but also carries such currents in much higher applied fields. The superior coil performance of Nb–40% Ti alloy has been utilized advantageously in the construction of a practical 100,000 gauss superconducting magnet. (auth)

30228 PHASE RELATIONS AND SUPERCONDUCTING PROPERTIES OF THE COLUMBIUM–HAFNIUM SYSTEM. R. E. Siemens, H. R. Babitzke, and H. Kato (Bureau of Mines, Albany, Ore.). 28p. (CONF-524-10)

From American Institute of Mining, Metallurgical and Petroleum Engineers Annual Meeting, New York, Feb. 1964.

The phase relations of the Nb–Hf system are studied, to serve as a basis for evaluation of these alloys as high-field superconductors. The system was investigated between 700 and 2400°C by melting-point, thermal-analysis, x-ray-diffraction, electrical-resistivity, and metallographic techniques. Results indicate the equilibrium diagram to be the beta isomorphous type, with Nb tending to stabilize the beta phase of Hf. Addition of 40 wt % Nb stabilizes the beta phase at 700°C. The solid solubility limit of the alpha Hf phase lies at 98 wt % Hf at 700°C. The allotropic transformation temperature of Hf was found to be 1750 ± 20°C. A minimum melting point occurs near 85 wt % Hf. (auth)

Radiation Effects

Refer also to abstracts 30031, 30157, 30897, and 30952.

30229 (BNL-8015) LOW-TEMPERATURE EMBRITTLEMENT OF IRON, IRON ALLOYS AND STEELS BY NEUTRON IRRADIATIONS. J. G. Y. Chow and S. B. McRickard (Brookhaven National Lab., Upton, N. Y.). [1964]. Contract AT-30-2-GEN-16. 28p. (CONF-512-6)

From American Society for Testing and Materials 67th Annual Meeting, Chicago, June 1964.

The low-temperature embrittlement of iron, iron alloys and A212B and modified Hy 80 steels in unirradiated and irradiated conditions was studied using the tensile test. A radiation-induced transition temperature (embrittlement) at 125 to 130°K occurs only in irons with carbon content of about 30 ppm or greater. Embrittlement occurs with exposure as low as 2×10^{18} nvt and the embrittling temperature does not increase with exposure. This embrittlement is attributed to a carbon-vacancy defect formed by trapping of a carbon atom by a radiation produced vacancy. Additions of substitutional alloys reduce this change in the embrittlement temperature. No correlation was found between the radiation-induced low-temperature tensile embrittlement and the shift in notched impact transition temperature observed at higher temperatures. (auth)

30230 (CERN-64-31) RANGE MEASUREMENTS FOR MUONS IN THE Gev REGION. A. Buhler, T. Massam, Th. Muller, and A. Zichichi (European Organization for Nuclear Research, Geneva). June 24, 1964. 18p.

The experimental method and results are given for meson (μ) range measurements in lead. Momenta were 1.2 to 2.5 Bev/c. (R.E.U.)

30231 (DP-888) DESTRUCTIVE EVALUATION OF IRRADIATED ZIRCALOY SHEATHING. McIntyre R. Louthan, Jr. (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). May 1964. Contract AT(07-2)-1. 15p.

The effect of irradiation on the ability of Zircaloy-sheathed oxide fuel tubes to withstand sheath strains during reactor service was determined by mechanical burst, weld-shear, and bend tests. The ductility of the sheath was not affected by irradiation exposures up to approximately 10^{20} fast nvt, and increases in the weld-shear strength were observed. (auth)

30232 (EURAEC-854) RELEASE OF XENON FROM GRAPHITE-MATRIX URANIUM CARBIDE (RARE-GAS DIFFUSION IN SOLIDS 13). P. Schmeling (Hahn-Meitner-Institut für Kernforschung, Berlin). 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 094-62-9-RDD. 21p. (EUR-1454.e)

A graphite-matrix fuel containing uranium carbide particles was investigated. The release of ^{133}Xe was studied in a number of multi-temperature PAD (post-activation diffusion) experiments. The release pattern was found to be complicated and often not reproducible with different specimens of the same preparation and pretreatment. A comparison is made between the observed release pattern and those found by other investigators, and an approximate release mechanism corresponding to all experimental facts is proposed. (auth)

30233 (GA-5123) IRRADIATION EFFECTS ON BERYLLIUM OXIDE MATERIALS. [PART] II. J. O. Barner (General Atomic Div. General Dynamics Corp., San Diego, Calif.). June 2, 1964. Contract AT(04-3)-187. 33p.

The results of the MGCR-2 irradiation experiment on beryllium oxide are presented. The neutron exposure for the experiment ranged from 1.03 to 10.6×10^{20} nvt (>1 Mev). The centerline temperature distribution of the samples ranged from 675 to 1330°F. Tensile strength of the irradiated specimens increased with increasing test temperature. The per cent retention of thermal conductivity of the irradiated BeO decreased significantly; however, it increased with test temperature. Photomicrographs revealed that grain-boundary separation had occurred throughout the irradiation capsule. Electron micrographs revealed the presence of helium bubbles in the grain boundaries. X-ray-diffraction studies showed that gross damage had occurred in the c_0 direction, while the damage in the a_0 direction was slight. Preliminary stored-energy release measurements indicated that large amounts of energy (~1300 cal/mole) were released upon heating irradiated BeO. (auth)

30234 (GA-5259) EFFECT OF NEUTRON IRRADIATION ON MATERIALS SUBJECTED TO MULTIAXIAL STRESS DISTRIBUTIONS. Quarterly Progress Report, January 1–March 31, 1964. P. W. Flynn and T. A. Trozera (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Apr. 30, 1964. Contract AT(04-3)-167. 7p.

The effects of radiation on the mechanical properties of A-302B steel is evaluated. A deformation theory is applied to correlate uniaxial tensile data with data from multiaxial stress distribution. (N.W.R.)

30235 (N64-20726) RADIATION DAMAGE TO SEMICONDUCTORS BY HIGH-ENERGY ELECTRON AND PROTON RADIATION. Progress Report, September 15, 1963–March 15, 1964. (Rensselaer Polytechnic Inst., Troy, N. Y.). 65p.

The general topics covered are: infrared studies on 40-Mev-electron-irradiated Si (both floating-zone and crucible grown); low-temperature (95 to 100°K) irradiation of Ge and Si by 40-Mev electrons (conductivity and Hall effect); 24 to 110 Mev proton bombardment at 300°K of Ge using carrier lifetime, conductivity, and Hall effect as probes of the radiation damage; and 12 to 52 Mev electron bombardment at 300°K of Ge and Si (conductivity and Hall effect). (auth)

30236 (NASA-CR-62) RADIATION DAMAGE TO SEMICONDUCTORS BY HIGH-ENERGY ELECTRON AND PROTON RADIATION. John C. Corelli and H. B. Huntington (Rensselaer Polytechnic Inst., Troy, N. Y.). July 1964. 70p.

Radiation damage of n-type Ge doped with As by 20- to 130-Mev protons is studied at 297°K. The resistivities of the samples studied extend from 1 to 10 ohm-cm. Defects induced in Ge (1 to 40 ohm-cm) and Si (1 to 10 ohm-cm) at room temperature by 10- to 50-Mev electrons are detected by Hall-effect and conductivity measurements. The experimental dependence of damage on the incident beam energy is compared with the predictions of several theoretical models. The implications of the results as regards acceptor levels and conduction bands are outlined. (T.F.H.)

30237 (NP-14069) RADIATION EFFECTS TEST IN GROUND TEST REACTOR. Final Report During Week of May 13, 1963. (Bendix Corp. Bendix Products Aerospace Div., South Bend, Ind.). Sept. 1963. Contract SNP-1. 65p. (BPAD-863-4-15090R)

Tests were performed on diodes, a torque motor, microswitch, feedback potentiometer, and magnetic amplifier to determine transient and permanent radiation effects upon NERVA control system electrical and mechanical components. The diodes were Texas Instruments type UG-59 and American Micro Devices types AM603 and AM713; the torque motor was Midwestern Instruments type 39-3; the feedback potentiometer Markite type 8038; the microswitch MH X-27516; the magnetic amplifier was from Magnetics, Inc. Wiring diagrams for the tests are shown. (R.E.U.)

30238 (NP-14102) EFFECT OF NUCLEAR RADIATION ON MATERIALS AT CRYOGENIC TEMPERATURES. Quarterly Progress Report No. 13, January–March 1964. (Lockheed-Georgia Co., Marietta, Ga.). Contract NASw-114. 50p. (ER-6929)

Room-temperature, out-of-pile testing was completed on tensile and tensile-notch alloy specimens. In-pile testing, after exposure to an integrated dose of 1×10^{17} nvt fast (>0.5 Mev) neutrons, was continued using sets of three specimens for each type of alloy and test. These have been completed for AISI type 304 and 347 stainless steel and titanium alloys 55A and 5% aluminum–$2\frac{1}{2}$% tin. The results of these tests are also reported. Temperature correlation and refrigeration control data were obtained from an instrumented aluminum alloy specimen to assure adequate temperature control of aluminum alloy test samples. These, in addition to similar data obtained from instrumented stainless steel and titanium specimens, provide adequate assurance of proper temperature control and the temperature correlation program has now been completed. Additional flux mapping was accomplished in the test position in HB-2 beam port, using low activation energy foils, to demonstrate the validity of the method used to determine exposure time and accumulated dose for the test specimens. Modifications to test and ancillary equipment were made to improve operational reliability and increase the quantity of useful data generated by the testing program. (auth)

30239 (RSIC-151) SPACE ENVIRONMENTAL EFFECTS ON MATERIALS AND COMPONENTS. VOLUME II. ELECTRONIC AND MECHANICAL COMPONENTS. D. J. Hamman and E. M. Wyler (Battelle Memorial Inst., Columbus, Ohio). Apr. 1, 1964. Contract DA-01-021-AMC-203(Z). 170p.

Presented are the results of a literature survey on Space Environmental Effects upon Materials and Components. The major emphasis of this literature survey is the effects of vacuum and space radiation on organic materials and electronic and mechanical components and materials. Volume I (RSIC-150) covers Elastomeric and Plastic Materials. (auth)

30240 (WANL-TME-109) RESULTS OF THE FIRST FIVE EXPERIMENTS CONDUCTED AT THE WESTERN NEW YORK NUCLEAR RESEARCH CENTER. H. P. Kalapaca, T. A. Pappas, T. P. Weldon, and D. Blewitt (Westinghouse Electric Corp. Astronuclear Lab., Pittsburgh). Aug. 27, 1962. 139p.

Radiation effects tests are reported for insulated wires and coaxial cables, resistors, capacitors, pulse preamplifiers (ceramic tube), and d-c preamplifiers. The experiments were performed in the A3 experimental hole of the WNY Reactor core. (R.E.U.)

30241 (AEC-tr-6231(p.44-7)) TEMPERATURE EFFECT OF LICHTENBERG IMAGE DUE TO ELECTRON BEAM IRRADIATION. K. Kimura and Y. Nakai. (Translation)

When a block of polymethyl methacrylate (PMMA) is irradiated on one surface with a high-enegy electron beam, a tree-like Lichtenberg image is formed due to damage by stopped electrons. The spread of the Lichtenberg image was studied for electron beam energies of 0.8 to 1.6 Mev and irradiation temperatures of −196, −78, and 27°C. The boundaries of the image were sharper and the spread smaller at the lower temperature. The reason for this phenomenon is not known. (D.L.C.)

30242 (AEC-tr-6231(p.61-70)) MEASUREMENT OF RADIATION DOSAGE BY POLYVINYL CHLORIDE FILM. Y. Omori, H. Iomo, K. Kimura, Y. Nakai, M. Matsuda, and S. Horikiri. (Translation)

Coloration of PVC film by a ^{60}Co gamma source and a Van de Graaff electron accelerator was studied in order to determine if it could be used in radiation dosimetry. Three types of PVC film were investigated: pure, with stabilizer, and with gelatin. (D.L.C.)

30243 (AEC-tr-6231(p.71-8)) COLORATION OF POLYVINYL CHLORIDE FILM BY GAMMA RAYS. A. Nishikawa, Y. Nakai, M. Matsuda, and K. Kimura. (Translation)

The relationship between optical density variations (at 276 and 340 mμ) and the radiation dosage was studied for various PVC films. The effects of the degree of polymerization were found to be negligible except for $\bar{P} = 1500$. The amount of solvent left in the film was found to be the greatest factor influencing density variations. (D.L.C.)

30244 (AEC-tr-6231(p.342-3)) EFFECTS OF GAMMA-RAY IRRADIATION ON SYNTHETIC FIBERS OF THE ACRYLONITRILE GROUP. Kiyoshi Suzuki. (Translation)

Polyacrylonitrile fiber and a copolymer of acrylonitrile and methyl methacrylate were irradiated in air and vacuum. The degree of polymerization, solubility, and tenacity

all decreased with irradiation of the polyacrylonitrile fiber, although the decreases in air and vacuum were different. Changes in the heat resistance of the polymer and copolymer were also measured. (D.L.C.)

30245 (ORNL-tr-179) CHARGED PARTICLE AND NEUTRON RADIATION EFFECTS IN CADMIUM SULFIDE. S. V. Starodubtsev, O. R. Niyavova, and A. E. Kiv. Translated by A. L. Monks (Oak Ridge National Lab., Tenn.), from Chapter 5 of "Radiatsionnye Effekty v Sul'fide Kadmiya," (a publication of the Publishing House of the Uzbek Academy of Sciences, Tashkent, 1963). 11p.

Among the topics discussed are: electron bombardment, cathode conductivity, photoconductivity, luminescence centers, surfaces, deuteron bombardment, and neutron diffraction. See NSA 17: 40897 for abstract of book in original. (D.L.C.)

30246 X-RAY-INDUCED FLUORESCENCE OF RUBY. W. Low (Massachusetts Inst. of Tech., Cambridge). Appl. Phys. Letters, 5: 35-7(July 15, 1964).

Fluorescence and phosphorescence induced by x-radiation in ruby crystals are discussed. The intensity of the R line fluorescence and the decay time were measured, and results are presented along with the absorption spectrum. Indication is given that one of the most important mechanisms is energy transfer from radiation centers to the R lines. (L.B.S.)

30247 THE UTILIZATION OF DAMAGE CAUSED IN METALS [FOR DOSE MEASUREMENTS]. G. Perriot. Bull. Inform. Sci. Tech. (Paris), No. 81, 101-6(Mar. 1964). (In French)

It is proposed to utilize variations in the resistivity of metals subjected to neutron bombardment in order to measure the corresponding doses. (auth)

30248 EFFECT OF Co^{60} GAMMA RADIATION ON WOOD. S. Bonotto, M. De Proost, M. Fidani, and R. Frassani (Centre d'Etude de l'Energie Nucleaire CEN, Mol, Belg.). Energia Nucl. (Milan), 11: 274-5(May 1964). (In Italian)

A gamma dose of 1.5×10^9 rads to a wood sample produced a decrease in volume, weight, and density and a large increase in simple sugar content. Glucose, arabinose, and xilose were found after irradiation, where only glucose was present in the control. Depolymerization of the polysaccharide bonds in the original wood may be explained by the direct action of gamma radiation and by indirect action, through formation of peroxides from the water in the initial wood. (M.J.T.)

30249 DAMAGE EFFECTS IN CaF_2:Mn AND LiF THERMOLUMINESCENT DOSIMETERS. M. J Marrone and F. H. Attix (Naval Research Lab., Washington, D. C.). Health Phys., 10: 431-6(June 1964).

The damaging effects of Co^{60} γ-ray exposures up to 10^9 r on the responsiveness of thermoluminescent dosimeters employing CaF_2:Mn or LiF as the phosphor were investigated for the purpose of establishing limitations on the applicability of these dosimeters for repeated use. Permanent damage in the γ-ray responsiveness of the LiF phosphor was observed for exposures of the order of 10^4 r, while the onset of appreciable permanent damage in the CaF_2:Mn phosphor was nearly four decades greater in exposure. (auth)

30250 ELECTRON PARAMAGNETIC RESONANCE IN IRRADIATED RHOMBIC SULFUR. A. Châtelain and J. Buttet (Université, Lausanne, Switzerland). Helv. Phys. Acta, 37: 77-8(1964). (In French)

The paramagnetism of rhombic sulfur was measured by electronic resonance at 940 and 9100 Mcps, after irradiation with 1- to 2-Mev neutrons at an integrated flux of $5 \times 10^{18}/cm^2$. At liquid nitrogen temperature, the signals were analogous to those observed in sublimated sulfur. Two lines were observed at 9100 Mcps and one at 940 Mcps, as in sublimated sulfur. After annealing at 195°K, the lines at 9100 Mcps were diminished, and the line at 940 Mcps was resolved into two lines. Apparently, sublimated sulfur is formed of fibers perpendicular to the surface on which it is condensed. (D.C.W.)

30251 RADIATION DAMAGE IN SOLIDS. H. Rieger (Max-Planck-Institut für Metallforschung, Stuttgart and Technische Hochschule, Stuttgart). Kerntechnik, 6: 193-8 (May 1964). (In German)

Concepts of the production and nature of radiation damage in solids are reviewed. The effects of radiation damage on some properties of ionic crystals, semiconductors, and metals are discussed. (auth)

30252 IRRADIATION TEST ON SWAGED UO_2 FUEL. I. IRRADIATION CONDITION, VISUAL EXAMINATION AND DIMENSIONAL CHANGE. Shuichiro Takahashi, Yoshinobu Seki, Tadashi Kubota, Yutaka Honda, and Tadahide Nohara (Mitsubishi Atomic Power Industry, Inc., Omiya, Japan). Nippon Genshiryoku Gakkaishi, 6: 254-60 (May 1964). (In Japanese)

In order to determine the in-reactor behavior of swaged UO_2 rods an irradiation test was performed. The irradiation specimens of cold-swaged, hot-swaged, and sintered-pellet fuel rods were assembled in one capsule and irradiated to 8×10^{20} nvt (2700 Mwd/t-UO_2). No appreciable change was observed in the outer appearance of the swaged fuel rods. The surface of the sintered-pellet rod was observed to be somewhat oxidized. No dimensional change was found in the swaged rods, but about 0.1 mm swelling was observed in the diameter of the sintered-pellet rod. (auth)

30253 NEUTRON IRRADIATION BRITTLENESS OF STRUCTURAL STEELS IN REACTORS. Yoshio Ando (Tokyo Univ.) and Tadato Fujimura. Nippon Genshiryoku Gakkaishi, 6: 270-8(May 1964). (In Japanese)

As a result of irradiation tests, it was found that the brittle-ductile transition temperature shifts to a higher temperature for structural steels when they are irradiated. Therefore, the problem of brittle fracture of the reactor pressure vessel was studied from the standpoint of the safety of reactor operation. Theoretical and experimental studies of neutron-induced brittleness are described and some of the problems encountered in irradiation tests are discussed. (auth)

30254 THE EFFECT OF NEUTRON IRRADIATION ON THE ELASTIC MODULI OF GRAPHITE SINGLE CRYSTALS. C. Baker and A. Kelly (Cambridge Univ., Eng.). Phil. Mag. (8), 9: 927-51(June 1964).

The resonant frequency in transverse vibration of natural single crystals of purified Ticonderoga graphite was measured as a function of neutron dose. The resonant frequency increases on irradiation by a factor of two and saturates at a dose of $\sim 4 \times 10^{17}$ nvt. Annealing reduces the resonant frequency again. The indentation hardness of the crystals was measured, and an electron microscopic investigation of the dislocation distribution in irradiated crystals was performed. The increase in resonant frequency on irradiation is shown to be due to a reduction of the strain produced by dislocation motion. Experimental values of $1/S_{44}$ and $1/S_{11}$ for graphite are presented. (auth)

30255 RADIATION DAMAGE IN SURFACE-BARRIER SILICON DETECTORS BOMBARDED BY 5.5-Mev ALPHA

PARTICLES. I. A. Baranov. Pribory i Tekhn. Eksperim., No. 2, 413-16(Mar.-Apr. 1964). (In Russian)

The effects of radiation damage in silicon surface-barrier detectors induced by 5.5-Mev alpha particles on the pulse size and form of the ^{241}Am alpha spectra and on the pulse size and form of the ^{235}U fission fragment spectra were investigated. The effects of radiation damage on the current-voltage characteristics and other properties of the detector were also examined. (tr-auth)

30256 EFFECT OF RADIATION DAMAGE ON THE RESPONSE OF SEMICONDUCTOR DETECTORS TO FISSION FRAGMENTS. H. C. Britt and G. C. Benson (Los Alamos Scientific Lab., N. Mex.). Rev. Sci. Instr., 35: 842-6(July 1964). (LADC-6173)

Measurements were made of the pulse-height defect as a function of integrated fission-fragment and alpha-particle fluxes for a gold surface barrier and a p-n junction detector. The measurements show that the pulse-height defects increase as the detectors are damaged by radiation and that incident fission fragments are more effective in producing radiation damage than are alpha particles. It was found that, as the detectors were damaged, the pulse-height defect increased more rapidly for the high energy fission-fragment group from ^{252}Cf than it did for the low energy group. It was also found that the rate of increase of the defect decreased as the electric field in the detector was increased. (auth)

30257 CHANGES IN THE ELECTRIC AND PHOTOELECTRIC PROPERTIES OF GALLIUM ARSENIDE CAUSED BY IRRADIATION WITH ELECTRONS OF ENERGY ~1 Mev. N. A. Vitovskii, T. V. Mashovets, S. M. Ryvkin, and R. Yu. Khanesevarov. Soviet Phys. Solid State (English Transl.), 5: 2575-85(June 1964). Translated from Fiz. Tverd. Tela, 5: 3510-23(Dec. 1963).

The results of an investigation of the energy spectra of radiation defects produced in gallium arsenide by 1-Mev electrons are presented. Both n- and p-type gallium arsenide with carrier concentrations of $2-8 \times 10^{16}/cm^3$ were irradiated. (D.C.W.)

30258 THE CONFIGURATION OF PRESSURE TANKS WITH REGARD TO BRITTLENESS HAZARDS AND NEUTRON RADIATION. Armin Erker, Eugen Klotzbuecher, and Ernst Pickel. Tech. Ueberwach., 5: 214-19(June 1964). (In German)

Literature on brittleness behavior of steel components, particularly in the field of nuclear reactors, was evaluated. Transition temperatures and crack limit temperatures were examined, and a brittleness-proof configuration of a reactor pressure vessel was calculated including a representation of comparisons with various types of material. (auth)

30259 ON THE EFFECTS OF PRELIMINARY IRRADIATION ON THE STRUCTURE AND THERMAL DECOMPOSITION OF CEMENTITE. V. A. Shalashov (Inst. of Textile Machine Building, Academy of Sciences, USSR). Zh. Fiz. Khim., 38: 485-8(Feb. 1964). (In Russian)

Studies were made of radiation effects on the structure and thermal decomposition of cementite (7.1% C, 0.39% Si, 0.51% Mn, 0.19% Cr and Fe) separated from white iron and irradiated for 12 hrs at 700°C. Graphite-like groupings, as centers of thermal decomposition, were observed in the metastable phase. The groupings are the result of broken bonds between Fe—C, forming —C—C bonds. (R.V.J.)

30260 INFLUENCE OF COLD WORK INDUCED DEFECTS UPON IRRADIATION GROWTH OF α URANIUM. C. Weinberg and Y. Quéré (CEN, Fontenay-aux-Roses, France). p.35-41 of "6e Colloque de Métallurgie. Relations Entre Défauts a l'Échelle Atomique et Propriétés Macroscopiques." Gif-sur-Yvette, France, Centre d'Études Nucléaires de Saclay and Paris, Presses Universitaires de France, 1962. (In French)

Measurements of thermal expansion allowed separation of the influences of texture and cold-work-induced defects on irradiation growth of α-uranium. It was then possible to see that growth is enhanced by defects (mainly dislocations) in a proportion that varies from 2.5 at liquid hydrogen temperature, to 16.5 at room temperature. (auth)

30261 EFFECTS OF NEUTRON IRRADIATION ON THE PROPERTIES OF SINTERED BERYLLIUM OXIDE AND MAGNESIUM OXIDE. J. Elston, C. Labbé, H. Nouguier, and M. Simbozel (CEN, Saclay, France). p.167-80 of "6e Colloque de Métallurgie. Relations Entre Défauts a l'Échelle Atomique et Propriétés Macroscopiques." Gif-sur-Yvette, France, Centre d'Études Nucléaires de Saclay and Paris, Presses Universitaires de France, 1962. (In French)

The effects of an irradiation performed at about 400°C, corresponding to an integrated fast neutron flux of 2.2×10^{20} $n_r \cdot cm^{-2}$ (E > 1 Mev), on properties of beryllium oxide and magnesium oxide were examined. Crystal parameters, specimen size, compression strength, and elastic modulus were studied. The influence of thermal treatments on some of the properties of the irradiated sintered samples was examined. (auth)

30262 AN INTERPRETATION OF LOW TEMPERATURE IRRADIATION DAMAGE EXPERIMENTS IN GRAPHITE. P. R. Goggin (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.181-8 of "6e Colloque de Métallurgie. Relations Entre Défauts a l'Échelle Atomique et Propriétés Macroscopiques." Gif-sur-Yvette, France, Centre d'Études Nucléaires de Saclay and Paris, Presses Universitaires de France, 1962.

A model is proposed to account for effects observed in low-temperature irradiation and annealing studies of graphite. The essential features are: a small repulsive force between single interstitials and vacancies and free motion of single interstitials and small groups of interstitials, with some estimates of the corresponding activation energies. The model was consistent with mechanisms recently proposed for the nucleation of high-flux irradiation. (auth)

30263 CONTRIBUTION TO THE STUDY OF FAST NEUTRON IRRADIATION DAMAGES OF MATERIALS. E. Cibois, J. Lemaire, and M. Weisz (CEN, Saclay, France). p.199-217 of "6e Colloque de Métallurgie. Relations Entre Défauts a l'Échelle Atomique et Propriétés Macroscopiques." Gif-sur-Yvette, France, Centre d'Études Nucléaires de Saclay and Paris, Presses Universitaires de France, 1962. (In French)

Research on fast-neutron irradiation damage of two materials for pressurized components of gas-cooled reactors, a weldable manganese-molybdenum steel and Zircaloy 2 is described. The microstructure influence on embrittlement and hardening after neutron irradiation was investigated. Shape and dispersion of precipitates, during cooling from the hot stable phase, was of great importance. The fine precipitates structures, spread in the matrix, were less embrittled. Some properties, in relation to the blue embrittleness of ferritic steels, seemed to be modified after irradiation. (auth)

30264 RADIATSIONNAYA FIZIKA. I. IONNYE KRISTALLY. (Radiation Physics. I. Ionic Crystals).

Ya. Zh. Kristapson, ed. Riga, Izdatel'stvo Akademii Nauk Latviiskoi SSR, 1964. 186p.

Seventeen articles are included on results of investigations of radiation defects, microstructure of impurity centers, and radioluminescence and photoluminescence of alkali-halide crystals. Investigations with these objectives were carried out using optical methods, electron paramagnetic resonance, and electron emission. Luminescence and radiation defects were studied for excitation by uv, x, and gamma, and reactor radiations. (M.J.T.)

30265 ANALYSIS OF SEMICONDUCTOR DEVICE RELIABILITY IN RADIATION ENVIRONMENTS. Frank W. Poblenz (Bendix Corp., Southfield, Mich.). p.585-91 of "Institute of Environmental Sciences, 1964 Proceedings." Mt. Prospect, Ill., Institute of Environmental Sciences, 1964.

The analysis of life test results using the Weibull distribution and graph is outlined, and typical plots of failure probability vs radiation exposure are included for transistors, diodes, and silicon controlled rectifiers. The plots show that bimodal failures can occur for certain rectifiers and unijunction transistors. The plotting technique permits extrapolation of radiation effects data to low failure probabilities. Suitable failure criteria are considered. (D.C.W.)

30266 PROCEEDINGS OF THE INTERNATIONAL SCHOOL OF PHYSICS "ENRICO FERMI." COURSE XVIII. RADIATION DAMAGE IN SOLIDS. CENTRO DI STUDI NUCLEARI DI ISPRA, DEL COMITATO NAZIONALE PER L'ENERGIA NUCLEARE, ISPRA, SEPTEMBER 5–SEPTEMBER 24, 1960. D. S. Billington, ed. New York, Academic Press, 1962. 949p. $32.00.

Separate abstracts were prepared for 31 of the 34 papers included. Three papers on radiation effects in ionic crystals, electron-induced radiation damage in pure metals, and fission damage in metals were previously abstracted in NSA (15: 24054, 28090; 16: 10618). (D.C.W.)

For abstracts of individual papers see: 29690, 30218, 30219, 30220, 30267, 30268, 30269, 30270, 30271, 30272, 30273, 30274, 30275, 30276, 30277, 30278, 30279, 30280, 30281, 30282, 30283, 30284, 30285, 30286, 30287, 30288, 30289, 30290, 30291, 30292, and 30504.

30267 INTRODUCTORY LECTURES ON CRYSTALLINE DEFECTS. J. Friedel (Faculte des Sciences, Paris). p.4-38 of "Radiation Damage in Solids." New York, Academic Press, 1962.

The production, behavior, effects, properties, and theory of defects, particularly static defects, are reviewed. The latter include surface defects, dislocations, and point effects. 110 references. (D.C.W.)

30268 TECHNIQUE AND APPLICATION OF TRANSMISSION ELECTRON MICROSCOPY. P. B. Hirsch (Cambridge Univ., Eng.). p.39-81 of "Radiation Damage in Solids." New York, Academic Press, 1962.

Techniques for observing defects, inhomogeneities, dislocation motion, climb, and precipitation are reviewed, together with theory for interpreting the contrast effects observed. Preparation and observation of sufficiently thin specimens are covered, and observations on defects in quenched and neutron-irradiated crystals are summarized. 65 references. (D.C.W.)

30269 THE EXPERIMENTAL OBSERVATION OF DISLOCATIONS AND RADIATION DAMAGE IN CRYSTALS BY SURFACE METHODS AND DECORATION TECHNIQUES. S. Amelinckx (Centre d'Etudes de l'Energie Nucleaire, Mol, Belg.). p.82-121 of "Radiation Damage in Solids." New York, Academic Press, 1962.

Observation of dislocations and radiation damage by crystal growth, etching, decoration, and evaporation is reviewed, together with specific applications of these techniques. 72 references. (D.C.W.)

30270 OBSERVATION OF CRYSTAL DEFECTS BY X-RAYS. I. EFFECT OF CRYSTAL IMPERFECTIONS ON THE DIFFRACTION OF X-RAYS. A. Guinier (Faculte des Sciences, Paris). p.122-51 of "Radiation Damage in Solids." New York, Academic Press, 1962. (In French)

The merits, limitations, and principles of observation of defects by x-ray diffraction and scattering are reviewed. The effects of imperfections on diffraction in both perfect and imperfect crystals are considered, and observations on neutron-irradiated LiF by scattering at small angles and scattering in general are used as illustrations. (D.C.W.)

30271 INFLUENCE OF LOCAL IRREGULARITIES ON LATTICE VIBRATIONS. G. F. Nardelli (CNEN, Ispra, Italy). p.152-68 of "Radiation Damage in Solids." New York, Academic Press, 1962.

The effects of local irregularities on the lattice dynamics and on the free energy of the lattice are calculated using the theory of local perturbations. Approximations are briefly considered. (D.C.W.)

30272 THE OBSERVED NATURE OF PRIMARY DAMAGE. M. W. Thompson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.169-81 of "Radiation Damage in Solids." New York, Academic Press, 1962.

Experimental evidence for momentum focusing of recoil atoms in solids under irradiation is reviewed, together with a theoretical interpretation. Some experiments on spikes in radiation damage are also summarized, and the current understanding of primary damage is briefly considered. (D.C.W.)

30273 TERMS AND CONCEPTS IN RADIATION DAMAGE THEORY. D. K. Holmes (Oak Ridge National Lab., Tenn.). p.182-226 of "Radiation Damage in Solids." New York, Academic Press, 1962.

Some basic theory of radiation damage, mainly theory for the production of such damage, is presented. The interactions and their effects are considered, with emphasis on the production of atomic displacements. Calculations are compared with experimental results. (D.C.W.)

30274 RADIATION DAMAGE THEORY. G. Leibfried (Technische Hochschule, Aachen and Kernforschungsanlage, Julich, Ger.). p.227-90 of "Radiation Damage in Solids." New York, Academic Press, 1962.

Theory for the primary and secondary processes arising only from energy transfer (no particle production) from the incident radiation to the constituents of the crystal lattice is reviewed. Comparisons are made with experimental observations. (D.C.W.)

30275 DYNAMIC STAGES OF RADIATION DAMAGE. G. H. Vineyard (Brookhaven National Lab., Upton, N. Y.). p.291-317 of "Radiation Damage in Solids." New York, Academic Press, 1962.

A numerical treatment of atomic processes in radiation damage events is outlined, and the results of calculations for copper are presented. The model (described) used permits consideration of lattice defects. (D.C.W.)

30276 RADIATION EFFECTS IN SEMICONDUCTORS. J. H. Crawford, Jr. (Oak Ridge National Lab., Tenn.). p.333-57 of "Radiation Damage in Solids." New York, Academic Press, 1962.

Models of and methods for determining defect-energy levels are reviewed, and experimental results associated with identification of defects are discussed in relation to the models. The effects of radioinduced disorder in diamond-lattice and zinc-blend structure semiconductors are then considered, with particular attention to disordered regions produced in Ge by neutrons. (D.C.W.)

30277 MOBILITY OF POINT DEFECTS IN GERMANIUM. P. Baruch (Ecole Normale Supérieure, Paris). p.375-83 of "Radiation Damage in Solids." New York, Academic Press, 1962. (In French)

Experimental observations on or related to the mobility of defects in Ge are examined in an attempt to identify the defects produced by irradiation. (D.C.W.)

30278 TRANSMUTATION DOPING AND RECOIL EFFECTS IN SEMICONDUCTORS EXPOSED TO THERMAL NEUTRONS. J. W. Cleland (Oak Ridge National Lab., Tenn.). p.384-97 of "Radiation Damage in Solids." New York, Academic Press, 1962.

The introduction of impurities into Ge and Si by the decay of nuclei excited by thermal neutron capture is discussed, together with the production of defects by recoil in the capture process. Experimental results and the capture properties of Si and Ge isotopes are included. (D.C.W.)

30279 INTRODUCTION TO IONIC CRYSTALS. G. Chiarotti (Università, Pavia, Italy). p. 398-421 of "Radiation Damage in Solids." New York, Academic Press, 1962.

Experimental and theoretical observations on the nature and interactions of defects in ionic crystals are reviewed, together with lattice calculations for alkali halides. Formation and migration energies for defects are compared with experimental values. The effect of defects upon the optical absorption of ionic crystals is also considered. 80 references. (D.C.W.)

30280 RADIATION DAMAGE IN COVALENT CRYSTALS. E. W. J. Mitchell (Univ. of Reading, Eng.). p. 518-46 of "Radiation Damage in Solids." New York, Academic Press, 1962.

The use of optical properties for studying defects is considered. Covalent binding and the absorption spectra of crystals are briefly discussed, together with the absorption coefficient and its relation to the number of absorption centers. The optical absorption centers induced in diamond, silicon, and quartz by the various radiations are then discussed in relation to their use in defect studies. Electrical measurements on diamond are also considered. (D.C.W.)

30281 ON THE BEHAVIOR OF VACANCIES IN PURE METALS. E. Germagnoli (Laboratori CISE, Milan and Istituto di Fisica del Politecnico, Milan). p.547-54 of "Radiation Damage in Solids." New York, Academic Press, 1962.

Some experimental observations on the behavior of simple defects by measurements of property changes in annealing, quenching, and self-diffusion are reviewed; and some other methods for detecting point defects are mentioned. (D.C.W.)

30282 RECENT PROGRESS IN A THEORY OF VACANCY-ANNEALING IN METALS. A. C. Damask (Pitman-Dunn Labs., Philadelphia). p.555-67 of "Radiation Damage in Solids." New York, Academic Press, 1962.

Differential equations for the concentrations in time of vacancies and vacancy-impurity complexes are presented and discussed, and calculations of annealing behavior are outlined. Results are displayed and discussed. Vacancy migration in impure metals is briefly considered, together with divacancy and trivacancy motion. (D.C.W.)

30283 THE EXPERIMENTAL STUDY OF POINT DEFECTS IN PURE METALS. R. O. Simmons (Univ. of Illinois, Urbana). p.568-93 of "Radiation Damage in Solids." New York, Academic Press, 1962.

The principles of observations on defects by measurement of the shape, volume, and x-ray diffraction changes due to the defects are reviewed, together with experimental techniques. Some measurements of radiation damage expansion and vacancy concentrations are summarized, and other types of experimental observations on defects are briefly considered. (D.C.W.)

30284 LOW-TEMPERATURE IRRADIATION STUDIES. T. H. Blewitt (Oak Ridge National Lab., Tenn.). p.630-716 of "Radiation Damage in Solids." New York, Academic Press, 1962.

Radiation damage studies at low temperatures are reviewed. Experimental techniques are summarized; and investigations of annealing kinetics (particularly annealing stages), impurity effects on annealing, stored energy due to radiation damage, shape and volume changes, radiation hardening, and annealing of radiation hardness are discussed. 53 references. (D.C.W.)

30285 THE MECHANISM OF RADIATION-HARDENING OF F.C.C. METALS BY FAST NEUTRONS. A. Seeger and U. Essmann (Max-Planck-Institut für Metallforschung, Stuttgart and Technische Hochschule, Stuttgart). p.717-52 of "Radiation Damage in Solids." New York, Academic Press, 1962.

The relation of the mechanism of radiation hardening of pile-irradiated crystals to radiation damage by fast neutrons is considered, using copper as the prime example. A theory of radiation damage by fast neutrons, with emphasis on hardening in fcc metals, is outlined and discussed in relation to recent experimental results. Some experiments on plastic deformation of irradiated copper crystals are then reviewed. Agreement among the results, other experiments, and theory are considered. 47 references. (D.C.W.)

30286 RADIATION DAMAGE IN BODY-CENTERED METALS. M. W. Thompson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.753-62 of "Radiation Damage in Solids." New York, Academic Press, 1962.

Some experimental observations on radiation damage and recovery in bcc metals are reviewed and compared with observations on fcc metals. The mechanisms of the recovery stages are considered, and a theoretical treatment of damage accumulation and recovery is presented. (D.C.W.)

30287 RADIATION-ENHANCED DIFFUSION IN METALS. A. C. Damask (Pitmann-Dunn Labs., Philadelphia). p.763-76 of "Radiation Damage in Solids." New York, Academic Press, 1962.

The increase under irradiation of diffusion in substitutional alloys in which diffusion occurs by a vacancy mechanism is discussed. Experimental observations on four types of diffusion enhancement by neutron irradiation are reviewed, and a simple theory for diffusion in a radiation field is outlined and compared with experiment. Direct observation and applications of enhanced diffusion are briefly considered, together with excess vacancy generation by cold work. (D.C.W.)

30288 RADIATION-DAMAGE STUDIES USING DISLOCATION PROPERTIES. D. K. Holmes (Oak Ridge National Lab., Tenn.). p.777-800 of "Radiation Damage in Solids." New York, Academic Press, 1962.

Theory for the effects of dislocations on the elastic moduli and internal friction of crystals and the effects of radiation defects on dislocation behavior is outlined and discussed in relation to experimental results. Investigations of dislocation properties and defects by dislocation effects are considered. (D.C.W.)

30289 THE FERROMAGNETIC AFTER-EFFECT IN IRRADIATED NICKEL AND ITS APPLICATION TO THE STUDY OF POINT DEFECTS IN F.C.C. METALS. A. Seeger, H. Kronmueller, P. Schiller, and H. Jaeger (Max-Planck-Institut für Metallforschung, Stuttgart). p.809-18 of "Radiation Damage in Solids." New York, Academic Press, 1962.

A method that permits separate observations on those point defects in cubic metals which have symmetry lower than cubic is discussed. The method involves demagnetization of the material and measurement of the initial susceptibility as a function of time. Some observations by this method and others are summarized. (D.C.W.)

30290 EFFECTS OF NEUTRON IRRADIATION ON MAGNETIC MATERIALS. G. Montalenti (Istituto Elettrotecnico Nazionale "G. Ferraris," Turin). p.819-29 of "Radiation Damage in Solids." New York, Academic Press, 1962. (In French)

Some experiments on the effects of neutrons on the magnetic properties of permanent magnets, alloys with high permeability, pure ferromagnetic metals, and ferrites are reviewed, together with proposed explanations. (D.C.W.)

30291 ATOMIC DISPLACEMENT AND IMPURITY EFFECTS IN FISSILE METALS. R. S. Barnes (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.860-87 of "Radiation Damage in Solids." New York, Academic Press, 1962.

The displacement and impurity effects of the transmutation products are discussed, together with the resultant effects on the hardness of the metal. Experimental observations and their interpretation are considered. (D.C.W.)

30292 EFFECTS OF RADIATION IN URANIUM. J. Blin (CEN, Fontenay-aux-Roses, France and Department du Plutonium, Fontenay-aux-Roses, France). p. 888-911 of "Radiation Damage in Solids." New York, Academic Press, 1962. (In French)

The effects of radiation on uranium are discussed using the results of experimental observations. Dimensional changes and their effects, particularly, are considered. A model for fission events is also discussed. (D.C.W.)

30293 A STUDY OF IRRADIATION-INDUCED ACTIVE SITES ON MAGNESIUM OXIDE BY USING ELECTRON PARAMAGNETIC RESONANCE. Jack H. Lunsford (Lewis Research Center, Cleveland). 14p. (CONF-110-6)

From American Institute of Chemical Engineers 56th Annual Meeting, 1963 Annual Meeting, Houston, Tex., Dec. 1963.

A study was made on the ultraviolet-radioinduced catalytic activity of MgO and the electron paramagnetic resonance spectra on the same sample. The data show that a correlation exists between the V_1 center concentration and the enhanced catalytic activity for the hydrogen-deuterium exchange reaction, $H_2 + D_2 \rightleftharpoons 2HD$. Samples were subjected to degassing at 290 and 500°C, thermal decay at −79, 0, and 30°C, 2537 Å UV as a function of time, and several wavelengths of UV light. It was concluded that either a V_1-type center existing on the surface is an active site for the exchange reaction, or the V_1 center formation is an integral step in the formation of the active site, that is, it is a hole trap that prevents recombination. (auth)

30294 ELECTRON-SPIN-RESONANCE OF BORON IN SINGLE CRYSTAL BeO. A. R. Reinberg (Texas Instruments Inc., Dallas). 20p. (CONF-481-68)

From American Physical Society Annual Meeting, New York, Jan. 1964.

Single crystals of synthetic BeO, which were irradiated with 6 Mev electrons, show an ESR spectrum at room temperature identified as being due to boron ions substituting for beryllium at normal lattice sites. The hyperfine tensor, $\bar{A}$ is cylindrically symmetric with its principal axis pointing towards one of the near oxygen bonds. Six equivalent directions are observed corresponding to the positions of the nonaxial nearest neighbor oxygen atoms. The constants of the spin Hamiltonian are: $g_{\parallel} = 2.0035 \pm 0.0005$, $g_{\perp} = 2.0044 \pm 0.0005$, $A_{\parallel} = 122$ Oe, $A_{\perp} = 76.5$ Oe. The spectrum is analyzed in terms of the paramagnetic electron occupying an antibonding orbital located along the direction of a B-O bond. Comparison of the observed hyperfine interaction with those expected for the free atom suggest deviations of the orbital from tetrahedral sp^3 configuration to one in which the ratio of the p to s contribution increases from $\sqrt{3}$ to 2.64 implying that the B-O bond is lengthened along the direction in which the paramagnetic electron is stabilized, the bond angle decreasing from 109 to 104°. (auth)

30295 EXPERIMENTAL INVESTIGATION OF SIMULATED SPACE PARTICULATE RADIATION EFFECTS ON MICROELECTRONICS. Emanuel Rind and Floyd R. Bryant (Langley Research Center, Hampton, Va.). 18p. (CONF-401-5)

From Institute of Electrical and Electronics Engineers 1964 International Convention, New York, Mar. 1964.

Microelectronics are adversely affected by radiation environments such as those found in outer space. These space radiation environments are summarized. Proton irradiation data at 22, 40, 128, and 440 Mev are presented for typical macroelectronic components such as low-, medium-, and high-frequency transistors and compared with similarly irradiated discrete- and integrated circuit types of microcomponents. Damage tended to vary inversely with energy. Integrated flux levels of approximately 10^{11} protons/cm^2 were needed before the radiation effects became noticeable. Integrated circuits appeared to be slightly more resistant to radiation but this finding may not be significant on a statistical basis. A typical experimental setup and circuit, which were actually used in the tests are illustrated and described. (auth)

METEOROLOGY

Refer also to abstract 29965.

30296 (EUR-1617.i) 5° ANNUARIO METEOROLOGICO. (5th Meteorological Annual Report). G. Bollini, C. Gandino, and B. Scaglianti (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy). 1963. 111p.

The meteorological year 1963, with its very cold winter, is described. After a description of instruments and observed atmospheric phenomena, tables and graphics are reported, with emphasis on thermo-hygrometric and atmospheric-diffusion features. (auth)

30297 (NYO-10498) HIGH ALTITUDE BALLOON SAMPLING PROGRAM. Second Interpretive Report. Progress Report. Herbert Feely and Fernando Bazan (Isotopes, Inc., Westwood, N. J.). June 1964. Contract AT(30-1)-3276. 44p.

The results of measurements of fission products and of neutron activation products in balloon filter samples collected at San Angelo (31°N) and at Mildura (34°S) indicate that there was a net southward flow of nuclear debris from the northern polar stratosphere, through the tropical stratosphere and into the southern polar stratosphere during 1963. The rate of this flow accelerated during mid-1963 in the Southern Hemisphere and during late 1963 in the Northern Hemisphere, probably as the result of an increase in the rate of turbulent exchange between the tropical and polar stratosphere. Comparison of data from balloon-collected samples with data from samples collected by WU-2 aircraft discloses no significant internal discrepancies. Stratospheric distributions of strontium-90 calculated from a combination of these two sets of data have been used to estimate the stratospheric burden of strontium-90 for a series of intervals during 1962 and 1963. This burden rose from about 2 megacuries in early 1962, following the late 1961 Soviet test series, to 3 megacuries following the mid-1962 United States test series, to over 7 megacuries following the late 1962 Soviet test series. By mid-1963 the stratospheric burden had decreased again to about 6 megacuries. (auth)

PHYSICS

General

30298 (AD-439695) RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM. Quarterly Progress Report No. 5, December 16, 1963–March 15, 1964. R. Novick (Columbia Univ., New York. Columbia Radiation Lab.). Contract DA-36-039SC-90789. 62p. (CU-3-64-SC-90789Phys.)

Studies have been made of the two-photon decay of the metastable helium ion. Precise values have been obtained for the hyperfine interaction constants in the $(3d^5 4p)^7P_{2,4}$ states of ^{53}Cr. Polarization and excitation studies are continuing on the $(1s2p)^3P - (1s2s)^3S$ transition in Li II preliminary to the determination of the ^3P fine structure. Detectors are being developed for the study of metastable autoionizing atomic states. Work is being resumed on the determination of the fine and hyperfine structure of the 3P term of Li I. Light sources and resonance cells are being developed for double-resonance spectroscopy in the radioactive isotopes of lead and copper. Precise measurements have been made of the hyperfine structure of the $3_{13} - 3_{03}$ rotational transition in NH_2D. Molecular magnetic rotation spectroscopy has been undertaken for the analysis of the vibrational structure of selected molecules. Work is described on the experiment designed to determine the interaction between free atoms and crystalline surfaces. A detailed ENDOR study of the V_K center in LiF has been completed. A discussion and interpretation are given of the angular dependence of the ENDOR lines arising from this center. The optical-maser-homodyne spectrometer is applied to problems in critical opalescence, fluid flow, and birefringence. Studies are being made of the fluorescence of a ruby crystal following excitation by ruby-laser light. (auth)

30299 (AFCRL-63-925) RESEARCH ON PHYSICS OF THE IONOSPHERE. Final Report. Sidney Borowitz (New York Univ., New York). Nov. 30, 1963. Contract AF19 (604)-4555. 10p. (AD-428963)

A general investigation of the structure of many-electron systems and scattering problems involving multichannel processes primarily, with some potential scattering included, are discussed. During the report period 26 reports were issued; a complete list of publications is included. (R.E.U.)

30300 (ANL-6854) EFFECT OF A TRANSVERSE MAGNETIC FIELD ON VERTICAL TWO-PHASE FLOW THROUGH A RECTANGULAR CHANNEL. Richard J. Thome (Argonne National Lab., Ill. and Associated Midwest Universities, Lemont, Ill.). Mar. 1964. Contract W-31-109-eng-38. 51p.

A study was undertaken to determine the effects of the magnetic field on: (1) distribution of gas in the field direction, (2) slip ratio, and (3) two-phase pressure drop. Metered streams of sodium-potassium alloy (NaK) and nitrogen were mixed and pumped through a vertical, constant-area, rectangular channel with a transverse magnetic field applied perpendicularly to the long side of the cross section. This system was comparable to a liquid metal magnetohydrodynamic generator operating on open circuit with a two-phase, two-component mixture as the working fluid. The results are briefly as follows: 1. The magnetic field tended to make the gas distribution more uniform. There was no observable tendency for the field to shift the gas to either side of the channel in the direction of the imposed field. 2. The effect of the magnetic field was to increase slip ratio in all cases. 3. The magnetic field was observed to virtually nullify the tendency for the introduction of a gaseous phase to greatly increase pressure drop above the single phase value at the same liquid flow rate. This effect was predicted reasonably well by a magnetic, two-phase, friction-factor multiplier which was based on a simplified model. (auth)

30301 (AROD-3420.8(Paper 6)) TRANSPORT PROPERTIES OF A SIMPLE GAS. Edward A. Desloge (Florida State Univ., Tallahassee). 44p.

The coefficients of diffusion, viscosity, and thermal conductivity of a simple gas are calculated by expanding the distribution function in Hermite polynomials, and obtaining an approximate solution to the Boltzmann transport equation. The techniques employed result in a number of simplifications of the usual derivations. (auth)

30302 (AROD-3420.8(Paper 7)) TRANSPORT PROPERTIES OF A GAS MIXTURE. Edward A. Desloge (Florida State Univ., Tallahassee). 27p.

The thermal and particle current densities of a gas mixture are derived by expanding the distribution functions in Laguerre polynomials and obtaining an approximate solution to the Boltzmann transport equation. The thermal diffusion factor is considered in detail. The techniques employed result in a number of simplifications of the usual derivations. (auth)

30303 (CEA-R-2336) CONTRIBUTION A L'ÉTUDE DE LA RÉSONANCE NUCLÉAIRE DANS LES MILIEUX MAGNÉTIQUES. (Contribution to the Study of Nuclear Resonance in Magnetic Media). Francoise Hartmann-Boutron (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1964. 91p.

Thesis submitted to Université, Paris.

An attempt is made to interpret the results of nuclear magnetic resonance experiments made by various workers on ferro- and ferrimagnetic compounds of the iron group. The problems encountered are the following: effects of the dipolar fields and the hyperfine structure anisotropy; signal intensity; frequency pulling due to the Suhl-Nakamura interaction between nuclear spins; nuclear relaxation and ferrimagnetic resonance in single domain samples of impure yttrium iron garnets; nuclear relaxation in the Bloch walls of insulators. The results of calculations are generally in good agreement with experiment. 84 references. (auth)

30304 (CONF-481-64) SOME PAST AND PRESENT USES OF NUCLEAR-EXPLOSION SOURCES IN PHYSICS. George A. Cowan (Los Alamos Scientific Lab., N. Mex.). [1967]. Contract W-7405-eng-36. 9p.

From American Physical Society Annual Meeting, New York, Jan. 1964.

Some experimental results obtained from nuclear weapons testing are reviewed. Included are multiple neutron capture from the "Mike" event of Nov. 1952, tracer studies in the upper atmosphere from "Orange" of 1958 and "Starfish" of 1962, neutron spectroscopy from "Cactus" and "Quay" of 1958 and "Gnome" of 1961, high altitude studies, and seismological effects studies. (R.E.U.)

30305 (D1-82-0340) LIFETIMES OF NONEQUILIBRIUM CARRIERS IN MAGNETIC TRAPS. Betsy Ancker-Johnson and Michael F. Berg (Boeing Scientific Research Labs., Seattle). Apr. 1964. 11p.

Nonequilibrium electrons and holes in approximately equal density are produced in p-InSb at 77°K by forcing a current greater than ohmic through the sample. The density decays exponentially after an initial rapid decay occurring in $\lesssim$ 200 nsec. The lifetime in the exponential region is 0.92 ± 0.05 μsec in the nonequilibrium carrier density range 0.9 to 2.1 × 10^{13} cm^{-3} when no magnetic fields are applied. The excess carrier density in the presence of a magnetic trap compared with that in its absence after a given decay time is observed to be enhanced by as much as 65%. The trap configuration used in these measurements is achieved by superposition of three static fields: (1) a uniform axial one; (2) a symmetric nonuniform axial field emanating from two current coils located one each in the planes of the sample ends; and (3) an axially symmetric transverse field in the form of a quadrupolar cusp. (2) May be made to add to (1) (positive end mirrors) or subtract from it (negative end mirrors). The application of (1) alone may cause appreciable loss of nonequilibrium carriers during the steady state. The end and wall mirrors restore completely this loss if the product of the driving current and (1) does not exceed a certain limit. The greatest influence on the nonequilibrium carrier densities remaining after given decay times so far observed occurs when the end mirrors are negative. Measurements are in progress to determine the nature of the decay process in magnetic traps. It is anticipated that these preliminary measurements can be markedly improved by optimizing the trap configuration. (auth)

30306 (EUR-1822.f) DETERMINATION DE LA DIFFUSIVITE THERMIQUE DES ISOLANTS PAR LA METHODE DU SIGNAL TRES BREF. (Determination of the Heat Diffusion Rate in Insulating Materials Using a Very Short Impulse). J. Faure (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy). 1964. 38p.

The classical theory which determines the thermal diffusion rate from the propagation of a heat impulse cannot be used in case of low conductivity materials. The signal propagation is too slow and thermal losses which the classical theory does not account cannot be neglected. In the present case, the mathematical formulation has been corrected to account for this effect. The problem has been solved and a simple apparatus has been designed to measure the thermal diffusion of insulating materials up to a temperature of 400°C. (auth)

30307 (IS-870) THERMAL CONTRIBUTIONS TO THE EQUATION OF STATE OF SOLIDS. C. A. Swenson (Ames Lab., Ames, Iowa). Apr. 1964. Contract W-7405-eng-82. 32p.

Various high-pressure and atmospheric-pressure data (both ultrasonic and piston-displacement) are analyzed to obtain a semiquantitative picture of the temperature-dependent lattice contributions to the equation of state of solids. Within the uncertainties of the various experiments, the isothermal bulk modulus B_T is found to be independent of temperature at constant volume for temperatures greater than the Debye temperature θ_D. This implies that the Grueneisen constant is proportional to the molar volume in this temperature region. B_T increases at constant volume as the temperature is decreased below θ_D with the magnitude of this observed increase (about 0.01 B_T) in qualitative agreement with that estimated from the Debye model. Much greater intrinsic temperature dependences (by factors of up to four or five) are found for the adiabatic bulk modulus and the shear constants. These considerations lead to a simple method for the extrapolation of room temperature pressure-volume data to low temperatures, and an application to the equation of state of indium metal is discussed. (auth)

30308 (NASA-TN-D-2345) EXPERIMENTAL EVIDENCE OF DEGRADATION EFFECTS IN SHORT SAMPLES OF HARD SUPERCONDUCTORS. John C. Fakan (National Aeronautics and Space Administration. Lewis Research Center, Cleveland) and Edward R. Schrader (Radio Corp. of America. RCA Labs., Princeton, N. J.). June 1964. 11p.

A set of experiments is described from which a model is proposed that may explain degradation of the current-carrying capacity of superconducting magnets. The model is used to explain the experimental results obtained on the basis of temperature excursions induced in the material as a result of the energy released by sporadic flux penetrations (flux jumps). Specifically, it is proposed that the current capacity of a superconducting electromagnet may be controlled by penetrations (in the temperature direction) of the critical surface that defines the superconducting region, and that these penetrations result from flux-jumping in the low-field-strength regions of the coil. Suggestions are given for minimizing or avoiding degradation in practical superconducting electromagnets. (auth)

30309 (NP-14087) MHD OF AN OSCILLATING SPHERE. Plasma Laboratory Report No. 10. Robin O. Motz (Columbia Univ., New York. School of Engineering and Applied Science). May 1964. 68p.

The case of a sphere executing small amplitude oscillations in an incompressible, conducting fluid with a uniform magnetic field aligned along the axis of oscillation is studied. For the case of large Hartmann number and large Reynolds number, the MHD equations are linearized for an inviscid fluid by a first order expansion in the magnetic Reynolds number of all quantities of interest. Solutions correct to $O(R_m)$ are obtained for the velocity and pressure of the fluid, and for the current, magnetic field, and electric field both outside and inside the sphere. The drag is found to be derivable from the Joule loss in the fluid, and the time dependent force on the sphere is given by $\vec{F} = -(2\pi/5)B_0^2 \sigma a^3 \vec{U}_0 e^{i\omega t}$. (auth)

30310 (NP-14096) NRL QUARTERLY ON NUCLEAR SCIENCE AND TECHNOLOGY. Progress Report, October–December 1963. (Naval Research Lab., Washington, D. C.). Jan. 1, 1964. 32p.

Separate abstracts were prepared for 4 of the 5 articles included. The remaining paper is on helium isotope resolution in primary cosmic radiation and was presented at the International Conference on Cosmic Rays, Jaipur, India, Dec. 2 to 14, 1963. (R.E.U.)

For abstracts of individual items see: 29566, 30349, 30515, and 30730.

30311 (PAN-301) QUADRUPOLE SPLITTING OF THE 14.4-Kev GAMMA LINE OF ^{57}Fe IN IRON SULPHATES OF THE JAROSITE GROUP. A. Z. Hrynkiewicz, D. S. Kulgawczuk (Polish Academy of Sciences. Inst. of Nuclear Physics, Krakow); and J. Kubisz (Poland. Academy of Mining and Metallurgy, Krakow). Dec. 1963. 9p.

The Mössbauer absorption spectra of the iron sulfates of the jarosite group were investigated. Some conclusions concerning the crystalline structure and the interaction of the iron ion Fe^{3+} with its surroundings are drawn. (auth)

30312 (PAN-486/II) A NEW DOUBLE-FREQUENCY METHOD FOR HALL COEFFICIENT MEASUREMENTS. H. Rzewuski and Z. Werner (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Dec. 1963. 13p.

A double-frequency method for the measurement of the Hall coefficient is described. An alternating magnetic field is generated in a coil with a ferrite core working in a series resonance circuit. The main advantages of the method are: possibility of placing the coil inside a cryostat; low driving power of the coil; and wide frequency range of the Hall voltage measurement. The sensitivity and range of measurement obtained are equivalent to the typical values for the d-c methods. (auth)

30313 (RTD-TDR-63-3021) INTERACTION OF PLANE ELASTIC WAVES WITH A CYLINDRICAL CAVITY. Stanley L. Paul and Arthur R. Robinson (Illinois. Univ., Urbana). June 1963. Contract AF29(601)-5007. 121p. (AD-415362)

A method is presented for computing stresses in the vicinity of a long cylindrical cavity in an infinite, elastic, isotropic, homogeneous medium when the cavity is enveloped by a plane stress wave traveling in a direction perpendicular to its axis. Hoop stresses around the cavity boundary were computed for the passage of a wave of dilation and a wave of pure shear; the stresses in the medium away from the boundary were computed for a wave of dilation. Initially the stress behind the incident wave front was considered to be constant. The effect of a stress decay behind the front was then computed by using the Duhamel integral for the case of an incident wave of dilation. The method of solution of the problem involves superposition of the stress field of an incoming plane step wave and a stress field corresponding to waves that diverge from a line source. (auth)

30314 (UCRL-7449) A METHOD OF CONTINUOUS SHOCK FRONT POSITION MEASUREMENT. M. Heusinkveld and F. Holzer (California. Univ., Livermore. Lawrence Radiation Lab.). July 31, 1963. Contract W-7405-eng-48. 14p.

A method for continuously measuring the position of a shock front in a solid, opaque medium was developed. The sensing element is a shorted transmission line, which forms part of the inductance of an oscillator. As the stress wave moves along the line, it crushes the cable progressively, thus changing the cable inductance and the oscillator frequency. The oscillator output is recorded as a function of time. This frequency record is converted to uncrushed cable length, and finally to a position-versus-time relation. (auth)

30315 (UCRL-10421(Rev.)) CONCENTRATION AND VELOCITY PROFILES IN A STEFAN DIFFUSION TUBE. Fred J. Heinzelmann, Darshanlal T. Wasan, and Charles R. Wilke (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley). Aug. 1963. Contract W-7405-eng-48. 37p.

The Stefan diffusion tube has been widely used as a means of determining vapor-phase diffusion coefficients. By this method the diffusion coefficient has been calculated on the assumption of plug-flow (flat) concentration and velocity profiles in the diffusion tube. These assumptions have been examined theoretically and experimentally in this study. The theoretical study and the experimental results indicate that the concentration profile is flat across the diffusion tube. Velocity and concentration profiles were estimated by approximate analytical solutions of the diffusion-convection equations. The velocity profile is found to be developing from a flat one near the liquid surface to a parabolic one at the other end of the tube. However, it is shown theoretically that the shape of the velocity profile does not affect the mass flux provided the concentration profile is flat. Thus diffusion data that have been calculated from Stefan diffusion tube data with the plug flow approximation are substantially correct. (auth)

30316 (Y-1470-G) X-RAY FLUORESCENCE TABLES: MICA-80 CRYSTAL. W. P. Amsbury, W. W. Lee, J. H. Rowan, and G. E. Walden (Union Carbide Corp. Nuclear Div. Y-12 Plant, Oak Ridge, Tenn.). Apr. 24, 1964. Contract W-7405-eng-26. 192p.

A critical compilation of standard reference tables of x-ray fluorescence lines is presented in convenient form for experimental use. This section of the report contains tables calculated for a mica-80 crystal. (auth)

30317 (AEC-tr-6231(p.34-40)) ELECTRON BEAM TRANSMISSION THROUGH ALUMINUM. S. Horikiri, Y. Nakai, H. Iomo, and K. Matsuda. (Translation)

The range of 0.8- to 1.6-Mev electrons in Al foils was measured by means of electric current measurements. The data are in good agreement with predicted values. The angular distribution of electrons due to forward and backward scattering was determined at 1.6 Mev. (D.L.C.)

30318 (AEC-tr-6231(p.41-3)) CALORIMETRIC MEASUREMENT OF ELECTRON BEAM INTENSITY. Y. Omori, Y. Nakai, H. Iomo, and M. Matsuda. (Translation)

The calorimetric method is the best method for measuring the electron beam intensity from a Van de Graaff accelerator for irradiation dose and energy absorption determinations. The principles of the method are described. The energy absorbed in a polyvinyl chloride film inserted in front of the calorimeter window is in good agreement with that obtained from film coloration. (D.L.C.)

30319 (JPRS-25344) RECOMBINATION RADIATION IN CADMIUM TELLURIDE DURING EXCITATION BY PULSES OF FAST ELECTRONS. V. S. Vavilov, E. L. Nolle, V. D. Egorov (Yegorov), and S. I. Vintovkin. Translated from Fiz. Tverd. Tela, 6: 1406-12(May 1964). 11p. (TT-64-31617)

During excitation by fast electrons, a recombination radiation originates in cadium telluride, the spectrum of which in the area of photon energies of 0.7 to 1.6 ev consists of three intensive bands with maximums at photon energies of 1.05 ± 0.01, 1.47 ± 0.01, and 1.59 ± 0.01 ev for 10°K. The temperature dependence of the intensity and position of the bands of recombination radiation in the temperature interval of 10 to 300°K was investigated. It was demonstrated that the short-wave radiation band lies in the area of the edge of the main absorption band and has a temperature shift factor equal to $-(4.0 \pm 0.1) \times 10^{-4}$ ev per degree. At 10°K the short-wave radiation band observes a structure in the form of steps, the origin of which is explained by the radiation junctions associated with the emission of longitudinal optical phonons with an energy of 0.020 ± 0.002 ev. The nature of the recombination radiation spectrum is discussed, and also the possibility of intensifying the radiation is discussed. (R.E.U.)

30320 (LA-tr-64-8) THE COURSE OF REACTIONS IN THE DETONATION WAVES OF EXPLOSIVE MIXTURES. A. Ya. Apin, I. M. Voskoboinikov, and G. S. Sosnova. Translated by Helen J. Chick and L. C. Smith (Los Alamos Scientific Lab., N. Mex.), from Zh. Prikl. Mekhan. i Techn. Fiz., No. 5, 115-17(1963). 9p.

Experimental data are given on the detonation velocities of different explosive mixtures, in which changes were observed in the wave fronts, as a function of charge diameter.

The degree of completion of the explosion was observed for a 10/90 suspension of lamp black in tetranitromethane, for a 90/10 mechanical mixture of ammonium perchlorate with paraffin, for a 90/10 mixture of TNT with colloidal boron, for a 58/42 mixture of hexogen with ammonium nitrate, and for a 30/70 suspension of hexogen in tetranitromethane gelatinized with 2% polymethylmethacrylate. (R.E.U.)

30321 (ORNL-tr-77) RADIATION EFFECTS IN THE INTERACTION OF ELECTROMAGNETIC RADIATION WITH CADMIUM SULFIDE. S. V. Starodubtsev, C. R. Niyazova, and A. E. Kiv. Translated by A. L. Monks (Oak Ridge National Lab., Tenn.), from Chapter 4 of "Radiatsionnye Effekty v Sul'fide Kadmiya," (a publication of the Publishing House of the Uzbek Academy of Sciences, Tashkent, 1963). 17p.

Photoconductive properties of CdS crystals when irradiated with electromagnetic radiation were studied. Mechanisms of exciton production and migration from visible radiation are considered. For abstract of entire book, see NSA 17: 40897. (R.E.U.)

30322 (UCRL-Trans-1056(L)) STIMULATION OF X RADIATION BY CANAL-RAY IMPACTS. C. Gerthsen and W. Reusse. Translated by Sergey Shewchuck (Univ. of California, Lawrence Radiation Lab., Livermore), from Physik. Z., 34: 478-82(1933). 13p.

Measurements are reported on the excitation of the $Al_{\bar{K}}Mg_{\bar{K}}$ radiation and of $Se_{\bar{L}}$ radiation for proton energies of 30 to 150 kv. The excitation energies are from 1.3 to 1.5 kev. (R.E.U.)

30323 THERMODYNAMICS OF A REACTING GAS. M. S. Vardya (Univ. of California, Berkeley). Am. J. Phys., 32: 520-5(July 1964).

Thermodynamic properties of a gaseous mixture undergoing dissociation or ionization, or both, are considered in a general way. As a special case, the behavior of ionizing hydrogen gas was studied. It is found that a perfect gas behaves as an imperfect gas in many ways, when undergoing dissociation or ionization. (auth)

30324 TRANSVERSE MAGNETOHYDRODYNAMIC WAVES IN THE MAGNETIC FIELD OF A DIPOLE. E. Infeld (Inst. for Nuclear Research, Warsaw). Bull. Acad. Polon. Sci., Ser. Sci., Math., Astron. Phys., 12: 161-6(1964).

The linearized equation for the fluid velocity of the Alfvén waves propagating in the field of a magnetic dipole is solved numerically. An upper limit of about 400 sec is obtained for the period of Alfvén waves in the F_2 layer of the ionosphere. (D.C.W.)

30325 THE RESTRICTED PROBLEM OF THREE BODIES. James H. Bartlett. Kgl. Danske Videnskab. Selskab, Mat.-Fys. Skrifter, 2: No. 7, 1-48(1964).

The case of two equal finite masses has been studied extensively, using Thiele variables, a modified Runge-Kutta method, and an electronic computer. Main classes have been traced continuously from beginning to end, and seven new classes are reported. For convenience, a class is represented by an eigensurface. General methods of locating periodic solutions, in particular asymmetric ones, are discussed. Initial and final conditions, in the form of tables and curves, are given for more than 800 periodic orbits. (auth)

30326 RANDON WALK MODEL AND NUCLEAR MAGNETIC RELAXATION IN A BCC LATTICE CONTAINING TWO NUCLEAR SPECIES. D. P. Tewari and G. S. Verma (Univ. of Allahabad, India). Phys. Letters, 10: 168-9 (June 1, 1964).

A random walk model was applied to dipolar relaxation by atomic diffusion in a bcc lattice containing two nuclear species. Expressions for T and T_2 in the high-field, low-temperature limit as well as the high-temperature, low-field case were derived for magnetic fields applied along the [100] and [110] directions. (D.C.W.)

30327 SINGULARITY CONDITION AND CONNECTED-DIAGRAM EXPANSION. S. Fujita (Université Libre, Brussels). Phys. Letters, 10: 175-6(June 1, 1964).

The singularity condition for systems with many degrees of freedom was investigated in the thermodynamic limit. It was found that this condition is closely related to the localized nature of interaction processes that brings out and maintains a system in thermodynamic equilibrium and that the condition can be considered as a validity condition for the irreducible-graph integrals in Mayers theory of an imperfect gas in thermodynamic equilibrium. From these considerations, the connected-diagram expansion, which is independent of any particular representation and the validity of which rests directly on the localized nature of interaction processes, was proposed for nonequilibrium problems. The connected-diagram expansion for a system of free electrons in an impurity potential field was developed. (D.C.W.)

30328 FREQUENCY PUSHING AND FREQUENCY PULLING IN A He–Ne GAS OPTICAL MASER. R. A. McFarlane (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., 135: A543-50(Aug. 3, 1964).

Measurements were made of the variation of beat frequency between two simultaneously oscillating axial modes of a He–Ne gas optical maser as their disposition with respect to line center was continuously varied and as the discharge excitation level was increased above beat threshold for fixed mode positions. The results are compared with the theory of Lamb. The calculations ignore mode interaction effects which are, however, included in Lamb's theory. The effects of frequency pushing, frequency pulling, and hole repulsion are apparent in the measurements as well as an excitation-dependent linewidth. (auth)

30329 ADIABATIC THEORY OF THE ELECTRON-PHONON INTERACTION. T. R. Koehler and R. K. Nesbet (International Business Machines Corp., San Jose, Calif.). Phys. Rev., 135: A638-9(Aug. 3, 1964).

Second-order corrections to the electronic energy due to the electron-phonon interaction were obtained previously using the formalism of the adiabatic theory. This result differs from the commonly accepted expression first given by Fröhlich. It is demonstrated that terms were omitted in the adiabatic theories which reconcile the two results. (auth)

30330 STATISTICAL THEORY OF SPIN-SPIN INTERACTIONS IN SOLIDS. W. J. C. Grant and M. W. P. Strandberg (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., 135: A715-26(Aug. 3, 1964).

A statistical theory of spin interactions is presented which takes its starting point from pair transitions rather than single-particle transitions. The approach through straightforward perturbation theory applied to pairs, and the approach through the time development of the pair-transition operator $S_x(t)$ are shown to be equivalent. The averaging over possible pair configurations is performed by means of a weight function which allows inclusion of the details of the lattice structure and of departures from random spin distribution. Concentration dependence and temperature dependence appear naturally in the formalism. The formalism is not intrinsically restricted to a particular type of spin interaction. Magnetic dipole forces, exchange

of any specified magnitude and any specified finite range, and cross-relaxation effects can be included. Several aspects of moment theory are clarified. The existence of asymmetry in certain line shapes is indicated. The theory is applied to magnetic dipole interaction and exchange. The Fourier transform of the magnetic resonance line shape is derived in an exact, explicit, and semiclosed form, in which the details of the system under consideration appear parametrically. A formula is given for all the moments of the line, but it is shown that moments bear a direct relation to the observed half-width only in the limit of very dense spin concentration. The results for limiting cases agree with those derived by Anderson and by Kubo and Tomita. In particular it appears that the line is always Lorentzian in the center and Gaussian in the wings, and that it approaches a pure Lorentzian shape as either the spin concentration or the effective nearest-neighbor distance become vanishingly small. (auth)

30331 PHONON SCATTERING BY THE F-CENTER ELECTRON. D. Walton (Oak Ridge National Lab., Tenn.). Phys. Rev., 135: A753-8(Aug. 3, 1964).

The scattering of phonons by the electron bound to the F center was calculated using conventional perturbation theory. The process is analogous to the scattering of light from an atom, with the electron making virtual transitions to an excited state. In this case it is found that the most important transitions are to a level lying above the first excited state. It is found that the scattering rate initially follows a Rayleigh law, being proportional to ω^4, where ω is the phonon frequency. However, as ω becomes larger than about half the Debye frequency, the scattering becomes weaker. Using the results of the calculation it was possible to account for most of the experimentally observed effect of F centers on the thermal conductivity. (auth)

30332 ON THE BLOCH REPRESENTATION OF ELECTRON-ELECTRON INTERACTIONS. W. Brauer (Physikalisch-Technisches Institut der Deutschen Akademie der Wissenschaften, Berlin). Phys. Status Solidi, 5: 139-44(1964). (In German)

Using the general expression for Bloch representation of the electron-electron interaction, in the reduced zone scheme, an exact relation was developed between the matrix element considered, and the matrix element of an electron-photon interaction, irrespective of normal or umklapp processes. The behavior of the matrix element for small wave-vector differences was studied, using the assumption that a center of inversion exists. (auth)

30333 LASERS WITH TWO ACTIVE CENTERS. V. S. Mashkevich (Inst. of Physics, Academy of Sciences, Ukrainian SSR). Ukr. Fiz. Zh., 8: 1260-3(1963). (In Ukrainian)

Equations were developed for a simple model with two active centers (Yb^{3+} and Nd^{3+}). Conditions producing the luminescence attenuation effect are studied. (R.V.J.)

30334 A NEW APPROXIMATE ONE-VELOCITY THEORY FOR TREATING BOTH ISOTROPIC AND ANISOTROPIC MULTIPLE SCATTERING PROBLEMS. PART I. INFINITE HOMOGENEOUS SCATTERING MEDIA. C. C. Grosjean (Universiteit, Ghent). Verhandel. Koninkl. Vlaam. Acad. Wetenschap., Belg., Kl. Wetenschap., No. 70, 1-119(1963).

The exact probabilistic treatment of steady-state one-velocity multiple scattering of particles in a uniform infinite medium, for an isotropic point source and for a rotationally symmetric anisotropic scattering law, is reviewed. A previous approximate multiple scattering formalism is surveyed. In this formalism, complicated scattering contributions are replaced by diffusion-type approximations not involving integral transforms and adjusted by appropriate moment conditions. The result is generalized to a formula for the scalar density due to an arbitrary distribution of isotropic sources. This formula and continuity equations lead to the particle current density. An extension to the case of convex homogeneous scattering media bounded by vacuum is outlined. A detailed description of the development of a new approximate formalism is presented. For isotropic scattering, the point source is represented by a sum of a rigorous asymptotic density term, a direct-beam term, and a diffusion-type transport correction. The generalization to anisotropic scattering is worked out in detail. The theory is applied to the case of a scattering law with two nonisotropic terms. General formulas for the scalar density and the vector current due to an arbitrary isotropic source distribution in an infinite uniform medium are derived. (M.J.T.)

30335 INSTITUTE OF ENVIRONMENTAL SCIENCES, 1964 ANNUAL TECHNICAL MEETING PROCEEDINGS, APRIL 13, 14, 15, 1964, PHILADELPHIA, PA. Mt. Prospect, Ill., Institute of Environmental Sciences, 1964. 712p.

Ninety-two papers are included on testing and analysis, acoustics, acceleration studies, cryogenics, data handling and instrumentation, earth environments, space environment simulation, radiation effects, reliability, shock studies, vacuum technology, development and test programs, and vibration testing. Separate abstracts were prepared for six papers. (D.C.W.)

For abstracts of individual papers see: 29856, 29857, 29962, 30066, 30265, and 31028.

30336 METHODS IN COMPUTATIONAL PHYSICS. ADVANCES IN RESEARCH AND APPLICATIONS. VOLUME 1. STATISTICAL PHYSICS. Berni Alder, Sidney Fernbach, and Manuel Rotenberg, eds. New York, Academic Press, 1963. 312p. $10.00

Separate abstracts were prepared for four of the eight papers included. One other paper on critical-size calculations by the Monte Carlo method was previously abstracted in NSA (17: 11462). The three remaining papers deal with Monte Carlo methods for percolation in cubic crystals, Ising lattice, and configurations of flexible polymer molecules. (D.C.W.)

For abstracts of individual papers see: 30063, 30704, 30705, and 30941.

30337 INTRODUCTORY TOPICS IN THEORETICAL PHYSICS. RELATIVITY, THERMODYNAMICS, KINETIC THEORY, AND STATISTICAL MECHANICS. Roald K. Wangsness. New York, John Wiley and Sons, Inc., 1963. 322p. $8.50.

Elements of special relativity, thermodynamics, statistical mechanics, and the kinetic theory of gases are developed. (D.C.W.)

Accelerators

Refer also to abstracts 29856, 29857, 30603, 30822, and 30940.

30338 (BNL-7921) A HIGH-CAPACITY DIGITAL DATA HANDLING SYSTEM FOR USE WITH COUNTER HODOSCOPES AND DIGITIZED SPARK CHAMBERS IN ON-LINE COMPUTER AGS EXPERIMENTS. K. J. Foley, W. Higinbotham, S. J. Lindenbaum, W. A. Love, S. Ozaki, D. Potter, and L. C. L. Yuan (Brookhaven National Lab., Upton, N. Y.). Mar. 2, 1964. Contract AT-30-2-GEN-16. 16p. (CONF-560-3)

From Conference on Film-less Spark Chamber Techniques and Associated Computer Use, Geneva, Mar. 1964.

A new digital data handling system and its application to experiments planned for the Brookhaven AGS on elementary-particle scattering are described. The system consists of 200 fast gates, two 48 × 4096 bit memory units (DDP model TCM-30) with associated electronics, two high-speed magnetic tape transports, and a direct link to a Merlin computer. (R.E.U.)

30339 (BNL-8033) A HYDROGEN THYRATRON MAGNET PULSER. E. B. Forsyth (Brookhaven National Lab., Upton, N. Y.). May 13, 1964. Contract AT-30-2-GEN-16. 13p. (CONF-557-1)

From Proceedings of the Eighth Symposium on Hydrogen Thyratrons and Modulators, Fort Monmouth, N. J., May 1964.

The design and operation of the magnet pulser, which forms part of a system to extract the high-energy proton beam from the Brookhaven AGS, is described. (R.E.U.)

30340 (BNL-8040) HARD TUBE MODULATOR FOR THE AGS LINAC RF POWER AMPLIFIER. Raymond H. Rheaume (Brookhaven National Lab., Upton, N. Y.). [1964]. Contract AT-30-2-GEN-16. 13p. (CONF-557-2)

From Proceedings of the Eighth Symposium on Hydrogen Thyratrons and Modulators, Fort Monmouth, N. J., May 1964.

The selection and operation of a hard tube pulse modulator for the r-f power amplifier for the AGS linac are discussed. TH-470 triodes were used. (R.E.U.)

30341 (CEA-R-2366) UNE SOURCE DE DEUTONS POLARISES ET SON APPLICATION EN PHYSIQUE NUCLEAIRE. (A Polarized Deuteron Source and Its Application to Nuclear Physics). Rene Beurtey (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1964. 78p.

Thesis submitted to Universite, Paris.

Principles and realization of a polarized deuteron source fitted to the 22-Mev Saclay cyclotron are described. Various vector and tensor polarizations are obtained using radio-frequency transitions between Zeeman sublevels of the deuterium atoms. Such polarized deuterons enable us the study of spin-dependent interactions in (d,d) scattering and (d,p) reactions. The asymmetries obtained by $^{40}Ca(d,d)^{40}Ca$, $^{12}C(d,p)^{13}C$, and $^{28}Si(d,p)^{29}Si$ are presented. (auth)

30342 (CERN-64-11) UNE METHODE D'ETUDE DES FAISCEAUX SECONDAIRES DE HAUTE ENERGIE DANS LE VIDE ET EN MILIEU DIFFUSEUR. (A Method of Study of Secondary Beams of High Energy in a Vacuum and in a Diffuser Medium). J. Fronteau (European Organization for Nuclear Research, Geneva). Feb. 25, 1964. 223p.

A method is presented for calculating the spectra of the beams emitted from a target or produced by decay of the particles of a secondary beam. Beam transport and transmission by a scatterer are both treated. Generalizations are made on the acceptance configuration and phase space. (D.C.W.)

30343 (CERN-64-24) LA CREATION DE CHAMPS MULTIPOLAIRES DANS UNE CHAMBRE A VIDE ELLIPTIQUE. (Production of Multipolar Fields in an Elliptical Vacuum Chamber). Y. Baconnier (European Organization for Nuclear Research, Geneva). May 27, 1964. 24p.

Current density calculations are presented for determining the parameters of quadrupoles, dipoles, and sextupoles to provide the constant magnetic fields desired in vacuum chambers for beam control. Permeability of both air and iron are considered. (D.C.W.)

30344 (CERN-64-25) MEASUREMENTS ON SLOW BEAM-EJECTION FROM THE CPS. C. Bovet, G. R. Lambertson, and K. H. Reich (European Organization for Nuclear Research, Geneva). June 3, 1964. 36p.

Experiments were performed that indicate that the resonant slow ejection is a successful and a predictable method. Advantages such as reduced emittance in the radial plane and high efficiency were shown to be realizable. Thus, spot sizes of, for example, two by two millimeters containing 80% of the circulating beam should be possible with a system designed for that purpose. In view of the critical dependence of the stability and smoothness of the burst on some of the machine parameters, feedback operation may eventually provide the most satisfactory control. Control of the ejected beam burst, ejection efficiency, beam emittance, and background problems was studied. (R.E.U.)

30345 (NAA-SR-130(Del.)) INTERIM FEASIBILITY REPORT ON MTA MARK III. (North American Aviation, Inc., Downey, Calif.). Apr. 23, 1951. Contract AT-11-1-GEN-8. 159p.

The overall feasibility of the MTA Mark III accelerator as a production unit is discussed. The Mark III is a proposed 300-Mev deuteron cyclotron employing a Thomas-type magnetic field. The deuterons are to be directed into a target of uranium or thorium where free spallation neutrons will be produced. These neutrons will then be absorbed in a lattice surrounding the beam target to produce special isotopes. Each part of the Mark III unit is discussed: the cyclotron, facilities for controlling the emergent beam, the beam target, and the lattice. In addition, a summary of chemical processing methods for the lattice feed material and a preliminary cost estimate are included The number of specific lattice designs, which are considered, is sufficient to provide for the production of either ^{239}Pu, ^{233}U, or tritium, for use of either solid or liquid feed materials, and for graphite or D_2O moderator in certain cases. In addition, lattice designs are presented that are suitable either for a deuteron beam that is released fairly uniformly around the periphery of the cyclotron, or one that emerges as a single beam of limited cross section. It is pointed out that the prospects of successful performance of a Mark III unit appear most encouraging, especially if further studies substantiate the feasibility of attaining the single beam operation. 28 diagrams. (auth)

30346 (NP-13982) ARBEITEN FUR DEN INJEKTOR DES 100-Mev FFAG-ELEKTRONENSYNCHROTRONS. (Report on the Injector of the 100-Mev FFAG Electron Synchrotron). W. Heinz (Berlin. Freie Universitat. I. Physikalisches Institut). Jan. 31, 1963. 15p.

The design and construction of the electron source was essentially concluded. The pulse generator was put in operation; work on the pulse transformer with a square pulse of about 1 μsec length and an amplitude of 200 kv is in progress. (tr-auth)

30347 (NP-13983) BETATRONSCHWINGUNGEN BEI ZEITLICH KONSTANTEM MAGNETFELD. (Betatron Oscillations at Constant Magnetic Field). W. Heinz (Berlin. Freie Universitat. I. Physikalisches Institut). May 3, 1963. 20p.

The motion of a singly charged particle in a circular accelerator with time-constant magnetic field and alternating gradients was examined. The particle was regarded as unaccelerated. The interactions of the particles (space charge effect, collisions with each other, and collisions with residual gas atoms), the beam attenuation, and the quantum effect were neglected. The equations of motion were first formulated in the Lagrange form and then in the Hamiltonian form suitable for numerical calculations. A magnetic

field with a symmetry plane was established for the solution of the motion equations. The periodic solution in the field was defined as the equilibrium path. Outside the symmetry position, the Taylor development of the field about this plane was used up to terms that are linear in the deviations. In further work, only solutions were considered that deviate little from the equilibrium orbit so that the selection of this special magnetic field represents no essential limiting of the universality. The assumption that the oscillation amplitude about the equilibrium orbit remains small leads to a coupling of radial and vertical motion. Two differential equations of the second order with periodic coefficients are given as equations of motion. Under the assumption that the azimuthal error dependency is given by a straight line function, the equations can be put in the form of Hill differential equations with straight-line coefficients. The stability behavior of such an equation is discussed, and the stability criterion was put in a suitable form. The method for the calculation of the characteristic exponents of the differential equations and their corresponding betatron frequencies in this linear approximation is given. (tr-auth)

30348 (NP-13987) ARBEITEN FUR DAS MAGNETFELD DES 100-Mev FFAG-ELEKTRONENSYNCHROTRONS. (Report on the Magnetic Field of the 100-Mev FFAG Electron Synchrotron). G. Wohlfeil (Berlin. Freie Universitat. I. Physikalisches Institut). Jan. 31, 1963. 13p.

Conditions which lead to controlled oscillations are given for the magnetic current circuit. Measurements of the current constancy were carried out on three circuits after stabilization of the control circuit. For two circuits (120 and 60 amp) a stability of about $\pm 5 \times 10^{-4}$ without drift was obtained. The 12-amp circuit showed drift phenomena after some hours of 1% up to 5%. Some magnetic field measurements were made in a partial magnet. It was shown that the graphic evaluation method by approximation to the mean over a large radius interval simulated a constancy of the field gradient. The gradient from place to place must be determined with a gradient probe, as numerical evaluation shows. (tr-auth)

30349 (NP-14096(p.23-9)) PROBLEMS IN THE FEEDBACK CORRECTION OF THE TRANSVERSE EDDY CURRENT INSTABILITY IN AN INTENSE ELECTRON BEAM. D. C. dePackh (Naval Research Lab., Washington, D. C.).

The control of the transverse eddy current instability of an electron beam in a conducting tube by means of inverse feedback is discussed. Parameters used are closely centered about the Sozotron project. (R.E.U.)

30350 (UCRL-11278) BEVATRON OPERATION AND DEVELOPMENT 38, APRIL–JUNE 1963. Kenneth C. Crebbin, William L. Everette, Calvin F. Hansen, Glen R. Lambertson, and William A. Wenzel (California. Univ., Berkeley. Lawrence Radiation Lab.). Apr. 7, 1964. Contract W-7405-eng-48. 22p.

The Bevatron beam was on for 82% of the scheduled operating time. There was one 68-hour scheduled shutdown. The external-proton-beam extraction system was successfully operated, extracting up to 50% of the circulating proton beam. The beam intensity at full energy seemed to be limited at about 2.4×10^{12} protons per pulse independent of an increase in intensity at the start of acceleration. Three new primary experiments were started this quarter. (auth)

30351 (UCRL-11279) BEVATRON OPERATION AND DEVELOPMENT 39, JULY–SEPTEMBER 1963. Kenneth C. Crebbin, William L. Everette, Calvin F. Hansen, and Harold W. Vogel (California. Univ., Berkeley. Lawrence Radiation Lab.). Apr. 13, 1964. Contract W-7405-eng-48. 20p.

The Bevatron provided beam for 86.8% of the scheduled operating time. There was a 4-day shutdown period including a 24-hr vacuum shutdown. The studies of the beam loss just after injection continued with no conclusive results. A new primary experiment was started using the external proton beam. There were some changes made in the main a-c power distribution for the Laboratory to try to correct for line fluctuations caused by pulsed equipment at the Bevatron. (auth)

30352 (AEC-tr-6231(p.14-33)) ON THE VAN DE GRAAFF ACCELERATOR. Y. Nakai. (Translation)

A summary is presented of the experiences in the operation of the Van de Graaff electron accelerator at Osaka Institute. The main features and installation of the accelerator are described. Some of the measurements (energy, current, beam intensity, stray radiation, and x rays) are given. Breakdowns and correction measures are discussed. (D.L.C.)

30353 (AEC-tr-6231(p.367-72)) THE ELECTRON ACCELERATOR AT THE TOKYO RESEARCH INSTITUTE. Kenichi Shinohara, Tomomichi Chigematsu, and Kikuo Kanaya. (Translation)

A description is given of the 3-Mev Van de Graaff accelerator. The dimensions, accessory equipment, and safety devices are discussed. The operation and performance of the accelerator are described briefly. (D.L.C.)

30354 (AEC-tr-6392) MATERIALS OF THE SCIENTIFIC TECHNICAL CONFERENCE ON NUCLEAR PHYSICS AND LINEAR ACCELERATORS, OCTOBER 10–14, 1961. PART III. STORAGE DEVICES. Translation of "Materialy Nauchno-Tekhnicheskoi Konferentsii po Yadernoi Fizike i Lineinym Uskoritelyam, 10-14 Oktyabra 1961 Goda. Chast' III. Nakopitel'nye Ustroistva" (a publication of the Physicotechnical Institute of the Academy of Sciences of the Ukrainian, SSR, Khar'kov, 1962). 102p.

Separate abstracts were prepared for 6 of the 7 articles presented; one was previously included in NSA (18: 16349). (R.E.U.)

For abstracts of individual papers see: 29930, 29931, 30355, 30356, 30357, and 30358.

30355 (AEC-tr-6392(p.1-20)) USE OF A MAGNETIC STORAGE DEVICE FOR EXPERIMENTS ON 100-Mev OPPOSITE ELECTRON BEAMS. I. A. Grishaev, A. E. Tolstoi, G. I. Evseev, and V. I. Artemov. Translated from p.3-27 of "Materialy Nauchno-Tekhnicheskoi Konferentsii po Yadernoi Fizike i Lineinym Uskoritelyam. Chast' III. Nakopitel'nye Ustroistva."

A description is given of a magnetic system designed for the production and control of stable circulating electron beams in order to carry out high-energy experiments within the "beam-beam" network. The results of preliminary investigations of the magnetic system are quoted, and techniques of measurements are described. (auth)

30356 (AEC-tr-6392(p.21-32)) HIGH-FREQUENCY SYSTEM OF THE EXPERIMENTAL 100-Mev "VP" UNIT. I. I. Koba, B. D. Shevchenko, and P. Ya. Yartsev. Translated from p.29-46 of "Materialy Nauchno-Tekhnicheskoi Konferentsii po Yadernoi Fizike i Lineinym Uskoritelyam. Chast' III. Nakopitel'nye Ustroistva."

The selection and substantiation of technical conditions and basic diagrams for a high-frequency system of the 100-Mev "VP" unit are considered. The h-f system is composed of an oscillatory system together with h-f power generator and h-f power transmission line from the power

generator to the oscillatory system, and is provided to compensate for radiative losses from high-energy electron beams in storage rings. (R.E.U.)

30357 (AEC-tr-6392(p.33-49)) INFLECTOR DEVICE FOR A 100-Mev ELECTRON STORAGE SYSTEM. (Design and Preliminary Experimental Results). V. L. Auslender, I. A. Grishaev, O. G. Il'in, and A. M. Shenderovich. Translated from p.47-69 of "Materialy Nauchno-Tekhnicheskoi Konferentsii po Yadernoi Fizike i Lineinym Uskoritelyam. Chast' III. Nakopitel'nye Ustroistva."

A study was made of the requirements which must be fulfilled by an inflector device for a 100-Mev electron storage circuit while using a linear accelerator as an injector. On the basis of these requirements a choice is being made of the type, parameters, and design of the pulse magnet, as well as a selection of the pulse shaping circuit for the magnetic field of the inflector. The preliminary results of an experimental study of the pulse shaping system are given. (auth)

30358 (AEC-tr-6392(p.50-67)) SELECTION OF OPTIMAL CONDITIONS FOR THE INTRODUCTION OF 100-Mev ELECTRONS INTO A STORAGE SYSTEM. V. L. Auslender, O. G. Il'in, and A. M. Shenderovich. Translated from p.71-93 of "Materialy Nauchno-Tekhnicheskoi Konferentsii po Yadernoi Fizike i Lineinym Uskoritelyam. Chast' III. Nakopitel'nye Ustroistva."

Determination of optimum conditions for particle introduction into the chamber and calculation of real conditions of shaping the pulse of the inflector field are discussed. (R.E.U.)

30359 (UCRL-Trans-1071) THEORY OF A NONLINEAR ACCELERATOR FOR HIGH ENERGY. Yu. F. Orlov. Translated by Maria Kassatkin (Univ. of California, Lawrence Radiation Lab., Berkeley), from p.508-26 of "Voprosy Fiziki Elementarnykh Chastits" (a publication of the Academy of Sciences, Armenian SSR). 1963. 29p.

A lecture is presented on the theory of nonlinear accelerators. Basic properties of nonlinear focusing, transverse phase stability, effects of various resonance perturbations, and protons and antiprotons in nonlinear focusing are considered. (R.E.U.)

30360 LONGITUDINAL PHASE SPACE TRANSFORMATIONS. A. J. Lichtenberg (Univ. of California, Berkeley). Nucl. Instr. Methods, 26: 243-9(Mar. 1964).

The linear theory of longitudinal phase space matching is developed. It is shown that one can match equivalently with harmonic potential wells or combinations of lenses and drift spaces. The theory is applied to phase and energy bunching. For linear accelerator pre-bunching, an application of phase bunching, the linear theory is used as a guide to a more exact non-linear calculation. For linear accelerator post-bunching, an application of energy bunching, the linear theory is shown to give adequate results. (auth)

30361 A SLOW EXPANSION SYSTEM FOR A BETATRON EMPLOYING SCR AND SR COUPLINGS. K. Abe, N. Kawamura, M. Sugawara, and M. Kimura (Tohoku Univ., Sendai). Nucl. Instr. Methods, 26: 250-2(Mar. 1964).

A description is given of a new type of slow expansion system for a 24-Mev betatron. An orbit expanding flux having an initial rise of steepness followed by a sufficiently long, gradual acclivity in waveform was successfully produced by phase-shift coupling between dual expander tank circuits with different resonant periods. Considerable reduction in the power consumption was obtained by oscillating the expansion currents for one period by means of reciprocal switches of a new kind, free from arcbacks. Semiconductor elements used in couples for the new switches provided several advantages of their own. (auth)

30362 ANOMALOUS EMISSION IN SECONDARY EMISSION BEAM MONITORS. S. Okabe, T. Tabata, and R. Ito (Radiation Center of Osaka Prefecture, Osaka). Nucl. Instr. Methods, 26: 349-50(Mar. 1964).

Characteristics of the secondary emission monitor (SEM) for electron beams were investigated. The decrease in the efficiency of the SEM with increasing voltage was investigated. A linear accelerator was used as a source of primary electrons, and it was found that this decrease sometimes shows a steep gradient or exhibits a peak. The secondary electron emission responsible for such behavior of the SEM is called anomalous emission. The characteristics of anomalous emission and the serious effects of this emission on the performance of SEM are reported. (C.E.S.)

30363 A THIN FOIL SECONDARY EMISSION MONITOR. D. Frerejacque and D. Benaksas (Ecole Normale Superieure, Orsay, France). Nucl. Instr. Methods, 26: 351-2(Mar. 1964).

The design of a thin-foil secondary emission monitor for electron beams is presented. The monitor consists of a collecting cylinder between two emitting foils. The foils are aluminum lightly coated with gold to stabilize the emission process. (C.E.S.)

30364 POSITRON YIELDS FROM A 45-Mev L-BAND ELECTRON LINEAR ACCELERATOR. R. E. Sund (General Atomic Div., General Dynamics Corp., San Diego, Calif.), R. B. Walton, N. J. Norris, and M. H. MacGregor. Nucl. Instr. Methods, 27: 109-21(Apr. 1964).

The characteristics of a positron beam produced by a converter system located after the first section of a three-section, L-band accelerator were investigated. The number of positrons emerging from the accelerator per electron incident on the converter was determined as a function of electron energy from 8 to 15 Mev. Other properties of the positron beam which were studied include the energy spectrum, the spot size, and electron contamination. The influence of the magnetic focussing fields on the positron yields was investigated, and the energy of the positrons leaving the converter which were preferentially accelerated was measured. Results of the yield measurements indicate that the present system, operating with an electron beam power of 4.5 kw on the converter, should yield an average positron beam current at the end of the accelerator of about 1.4×10^{-9} A within a $2\frac{1}{2}\%$ energy interval at 25 Mev. The energy of the positron beam can be varied continuously from several Mev to 33 Mev, and the current within $2\frac{1}{2}\%$ energy bin is approximately proportional to positron energy. Calculations of positron yields and beam characteristics performed for electron bombarding energies of 9 and 17 Mev gave results in good agreement with experimental observations. The calculations also give a conceptual picture of the positron production in the converter and subsequent trapping and acceleration by the accelerator. (auth)

30365 THE TURIN 100-Mev ELECTRON SYNCHROTRON. L. Gonella (Università, Turin and Istituto Nazionale di Fisica Nucleare, Turin), H. Nabholz, and R. Wideroee. Nucl. Instr. Methods, 27: 141-55(Apr. 1964).

A 100-Mev electron synchrotron is described, with particular attention to the empirical details of construction and operation. A separate flux-forced circuit is used for the betatron phase of acceleration (up to 2 Mev)—a special

½λ r-f resonator for the synchronous acceleration. Two beams in opposite directions are available with intensities higher than 1000ρ/min · m. A collimated beam of high-energy electrons was successfully extracted from the machine. (auth)

30366 ENGINEERING TECHNIQUES IN NIMROD. Nucl. Eng., 9: 197-200(June 1964).

The 7-Bev weak-focusing constant-gradient proton synchrotron, NIMROD, was designed for a maximum beam current of 10^{12} protons. The main vacuum chamber, pump-out systems, main magnet, low-temperature techniques, and instrumentation are described. (M.C.G.)

30367 PARTICLE ACCELERATOR APPLICATIONS. E. Vernin (SAMES, France). Nucl. Eng., 9: 201-3(June 1964).

Uses of electron and positive ion accelerators are discussed. Radiation damage studies, activation analysis, health physics studies, neutron therapy, target development, ion source studies, production of short-lived isotopes, soil studies, oil prospecting, shielding studies, and radiosynthesis are among those applications discussed. (M.C.G.)

30368 LINEAR ACCELERATORS—SOME ENGINEERING DEVELOPMENTS SINCE 1947. Maurice G. Kelliher [(Vickers Research Ltd., Sunninghill, Berks, Eng.)]. Nucl. Eng., 9: 208-12(June 1964).

Development of linear accelerators and their various applications are discussed. Engineering problems, including accelerating tubes, choice of operating frequency, pulse shortening, and isocentric mounting, are described. (M.C.G.)

30369 EXTERNAL INJECTION IN ELECTRON CYCLIC ACCELERATOR. V. V. Ekivin (Moscow State Univ.). Pribory i Tekhn. Eksperim., No. 2, 17-18(Mar.-Apr. 1964). (In Russian)

A method for introducing electrons into betatrons from an injector located outside the acceleration chamber is described. This method permits the injection of electrons of a narrow energy spectra and increases the intensity of the beam. (tr-auth)

30370 HIGH-CURRENT INJECTOR OF HYDROGEN IONS. R. A. Demipkhanov, O. F. Poroshin, P. E. Belensov, and G. P. Mkheidze (Inst. of Physics and Tech., USSR). Pribory i Tekhn. Eksperim., No. 2, 19-21(Mar.-Apr. 1964). (In Russian)

A high-current injector for hydrogen ions is described. The injector can operate continuously with a beam current of 275 mamp and a relatively high beam directivity coefficient of 7 amp cm^{-2}. The hydrogen ions are extracted from a plasma with an operating voltage of 45 kv. (tr-auth)

30371 DEVICE FOR REPRODUCING THE FORM OF CURRENT PULSES. A. A. Glazov and L. M. Onishchenko (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekhn. Eksperim., No. 2, 100-4(Mar.-Apr. 1964). (In Russian)

A simple device for reproducing the form of current pulses flowing through a conduit or the current of a pulsed beam of charged particles is described. The device uses a Rogovskii loop. The performance of the device for a current pulse is analyzed and compared with theoretical results. (tr-auth)

30372 ELECTRON BUNCHING IN A SYSTEM OF ATTENUATING FIELDS AND COULOMB REPULSION FORCES. Yu. N. Badlevskii. Radiotekhn. i Elektron., 8: 1440-50(Aug. 1963). (In Russian)

The influence of space charge on bunching and on the formation of current harmonics in an electron beam in a traveling-wave tube was studied at large incoming amplitudes. The behavior of current harmonics with small space charge and various input signal amplitudes was investigated. (tr-auth)

30373 CHARGE RADIATION DURING CIRCULAR MOTION. L. A. Vainshtein (Inst. of Problems in Physics, Academy of Sciences, USSR). Radiotekhn. i Elektron., 8: 1698-1705(Oct. 1963). (In Russian)

Theoretical studies were made of the electromagnetic field produced at each harmonic frequency of revolution by a charged particle moving with a steady motion around a circle. Calculations on the electric field near the orbit were used for developing expressions for particle energy emitted at each harmonic. The expression was generalized for a particle moving in a homogeneous isotropic medium with emission induced by acceleration and the Cherenkov effect. The obtained formulas allow a determination of the structure of the entire field except for a small toroidal region adjacent to the orbit. (tr-auth)

30374 TORQUE REVERSING DRIVE FOR LIGHT DC TARGET MOTOR. A. V. Feltman and J. G. Cottingham (Brookhaven National Lab., Upton, N. Y.). Rev. Sci. Instr., 35: 814-15(July 1964). (BNL-7549)

A silicon-controlled rectifier driver for Cosmotron target motors was developed. This driver controls a motor to produce accelerating and braking torques for optimum target transport times. It features simplicity and reliability with minimum components. (auth)

30375 HIGH CURRENT LINEAR INDUCTION ACCELERATOR FOR ELECTRONS. N. C. Christofilos, R. E. Hester, W. A. S. Lamb, D. D. Reagan, W. A. Sherwood, and R. E. Wright (Univ. of California, Livermore). Rev. Sci. Instr., 35: 886-90(July 1964). (UCRL-7408(Rev.I))

A 150-amp, 4-Mev electron accelerator was designed and constructed for use in the Astron experiment. Design requirements include a beam quality less than 10^{-2} rad·cm and an energy spread of ±0.5%; the pulse length is 0.25 μsec and the repetition rate is variable to a maximum of 60/sec. The accelerating principle used is magnetic induction. Design features and the results of preliminary operation are discussed. (auth)

30376 KINEMATIC METHOD FOR DETERMINATION OF ACCELERATOR BEAM ENERGIES. B. M. Bardin and M. E. Rickey (Univ. of Colorado, Boulder). Rev. Sci. Instr., 35: 902-3(July 1964). (UCOL-522)

A method for determination of accelerator beam energies using hybrid targets is described. A target consisting of a homogeneous mixture of reference nuclei having well-known excited states and projectile nuclei is used. Determination of the crossover angle at which recoil projectile particles and inelastically scattered particles from reference nuclei produce equal pulse heights is shown to provide a beam energy measurement. No special apparatus is required. The method is applicable over a wide range of energies. An alternative related measurement using other hybrid targets is discussed briefly. (auth)

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Refer also to abstracts 30671 and 30930.

30377 (CONF-320-5) X-RAY PRODUCTION IN SUPERNOVA REMNANTS. G. W. Clark and M. Oda (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science). [1963]. Contract [AT(30-1)-2098]. 7p.

From the International Conference on Cosmic Rays, Jaipur, India, Dec. 1963.

The spectrum of electromagnetic radiation that would be produced by electrons with a specific energy spectrum as they undergo synchrotron emission, inverse Compton collisions with starlight, and radiative collisions (bremsstrahlung) is calculated. (R.E.U.)

30378 (NASA-CR-55384) PLANETARY PHYSICS. NOTES FOR THE SUMMER INSTITUTE IN PLANETARY PHYSICS. Appendix VI. Gordon J. F. MacDonald (California. Univ., Los Angeles). 1963. 361p.

Three papers were presented: the internal constitutions of the inner planets and the moon; the escape of helium from the earth's atmosphere; and hydromagnetic waves in space. A separate abstract was prepared for the last paper; the others were previously included in NSA (16: 29608 and 17: 37360). (R.E.U.)

For an abstract of the individual paper see: 30379.

30379 (NASA-CR-55384(p.313-68)) HYDROMAGNETIC WAVES IN SPACE. Gordon J. F. MacDonald (California. Univ., Los Angeles). (N64-15185)

Waves in a compressible, nondissipative, hydromagnetic medium are described. The detailed geometry of the wave solutions are described, and the observable properties of the waves are considered. The problem of the refraction and reflection of hydromagnetic waves at sharp boundaries is also considered. Also discussed are the hydromagnetic waves at the surface of the earth and of satellites. (R.E.U.)

30380 (NP-14051) BESTIMMUNG DER ELEKTRONENDICHTE DER SONNENKORONA (these). (Determination of Electron Density in the Solar Corona (thesis)). Georg Widmer (Zurich. Eidgenössische Technische Hochschule). 1963. 40p.

A method is developed for the determination of electron density distributions in a rotationally symmetric solar corona. Under this assumption, taking into consideration anisotropic scattering and limb darkening, the integral equations are derived for each heliographic latitude and for different cases of polarization. The equations, just as their analytically feasible inverse transformations, are of the Volterra-type. Computations of densities are worked out using the explicit formula by numerical integrations over brightness distributions on different cuttings perpendicular to the solar axis. An ALGOL program was written to be used by a computer, which allows future calculations for any distribution of measured points and for each case of polarization. Density distributions are given for the minimum corona of 1954 and represented in an isoelectron density map. (auth)

30381 (UCRL-Trans-1069(L)(Pt.2)) THE NUMERICAL INTEGRATION OF THE n-BODY PROBLEM FOR STAR CLUSTERS. PART II. Sebastian von Hoerner. Translated for Univ. of California Lawrence Radiation Lab., from Z. Astrophys., 57: 47-82(1963). 33p.

The 6n equations of a motion of n stars in a random cluster are integrated for n = 25; one example over 40 times of relaxation, a second one over 24. This covers more than the actual age of globular clusters and of clusters of galaxies, and of most of the galactic clusters. Though both examples show differences in their development, their general trend of development is the same. The distributions of density, velocity, and energy (and their change with time) are investigated. While their mean values stay remarkably constant, their standard deviations increase steadily with time. This might be used for age estimates. It also shows that theoretical cluster models cannot be given in general but only as a function of age. The density distribution spreads over 3 orders of magnitude in r, and over 9 orders in the density ρ near the end of the calculation. At the center, the density builds a sharp cusp with about $\rho \sim r^{-2}$, and the outermost parts give about $\rho \sim r^{-4}$. Within a factor of six, $\rho \sim r^{-3}$ would be a rough approximation over the whole region covered; the isothermal polytrope cannot be used as an approximation at all. The velocity distribution is very different from a Maxwellian: the excess of high velocities is due to close pairs and groups at the center, and the excess of low velocities belongs to stars of high energy, lingering close to their apocenter at large r. The energy distribution forms a pointed maximum at low negative energies close to zero and drops toward large negative energies about $\sim(-E)^{-p}$, with p decreasing with time. No distinction between a "remaining cluster" and an "outer region" is possible, since the density drops smoothly from its central cusp to the outermost star. The supply of stars with positive energy is much less than theoretically expected, thus the disintegration of clusters by their internal exchange of energy is slow. An approximate formula for calculating the density distribution from the energy distribution is given and checked. With this formula, the partial differential equation for the time-development of the energy distribution is derived; it shows some similarity to the equation of heat conduction. (auth)

30382 DYNAMICS OF THE SOLAR WIND. F. L. Scarf and L. M. Noble (TRW Space Technology Labs., Redondo Beach, Calif.). AIAA (Am. Inst. Aeron. Astronaut.) J., 2: 1158-60(June 1964).

Previous treatment of the solar wind is extended by inclusion of appropriate viscous dissipation terms in the hydrodynamic equations and by development of additional solutions for the lower corona. It is shown that, at an intermediate distance from the solar surface, as the fluid becomes less dense, the usual form of the transport coefficient equations becomes inapplicable, and ultimately the continuum equations break down, and a form of free molecular flow sets in. The transition to free or field-dominated flow is discussed and treated approximately. (M.J.T.)

30383 THE CHEMICAL COMPOSITION OF TWO CH STARS, HD 26 AND HD 201626. George Wallerstein (Univ. of California, Berkeley) and Jesse L. Greenstein. Astrophys. J., 139: 1163-79(May 15, 1964).

The high-velocity CH stars appear to be deficient in metals but rich in carbon and heavy elements. By a comparative curve-of-growth analysis using the G8 III star ϵ Virginis as a standard, it was found that the CH stars, HD 26 and HD 201626, are metal poor by factors of 5 and 30, respectively. Both stars show a carbon-to-iron ratio 5 times higher than ϵ Vir. There is no evidence for the presence of ^{13}C. In addition, both show an excess of Ba, La, Ce, and Nd with respect to Fe, by factors of about 20. Eu is enhanced by only a factor of 5 in HD 26, and by less than 2 in HD 201626. Except for their general metal deficiency these stars have relative abundances of C : Fe : Ba very similar to the population I Ba II star, HD 46407. The abundance anomalies are interpreted as produced by helium burning and neutron addition to the iron-peak elements. Two possible models are proposed in which ^{12}C is first produced and then partially processed to ^{13}C by protons that are mixed in. The ^{13}C is then the source of the neutrons through $^{13}C(\alpha,n)^{16}O$. The ^{14}N is destroyed by $^{14}N(\alpha,\gamma)^{18}F(\beta^+\nu)^{18}O$. These events need occur in only 1 to 3 per cent of the mass of stellar material, which is sufficient when mixed with the outer envelope of the star to produce the observed abundance anomalies. The high

space velocities and galactic distribution as well as the low metal content indicate that the CH stars belong to the halo population. The absolute magnitudes of these stars are found to be about +0.5 and −0.4 for HD 26 and HD 201626, respectively. Combined with their intrinsic colors, $B - V = 1^{m}05$, this places them to the right of the nearly vertical part of the giant branch of the color-magnitude diagram of globular clusters. (auth)

30384 ON LARGE-SCALE INSTABILITIES DURING GRAVITATIONAL COLLAPSE AND THE EVOLUTION OF SHRINKING MACLAURIN SPHEROIDS. D. Lynden-Bell (Cambridge Univ., Eng.). Astrophys. J., 139: 1195-1216 (May 15, 1964).

The collapse of a rotating, pressureless, self-gravitating spheroid is computed and shown to be unstable against small second harmonic deformation throughout the period of collapse into a disk. The disk actually formed may thus be considerably elongated along a diameter. This phenomenon may be significant in the formation of galaxies. The instability due to friction that occurs in the classical sequence of Maclaurin spheroids at their point of bifurcation with the Jacobi ellipsoids develops only if the spheroid is shrinking more slowly than viscosity can dissipate the energy. Small tides raised by another body have little effect except when they resonate at a natural frequency of the spheroid. Chandrasekhar's virial tensor method can be used to discuss time-varying ellipsoids provided the velocities are linear functions of position. (auth)

30385 THE DYNAMICAL INSTABILITY OF THE WHITE-DWARF CONFIGURATIONS APPROACHING THE LIMITING MASS. S. Chandrasekhar and Robert F. Tooper (Univ. of Chicago). Astrophys. J., 139: 1396-8(May 15, 1964).

It is verified that, if the effects of general relativity are allowed for, the white-dwarf configurations become unstable long before the Schwarzschild limit on the radius is reached, in agreement with the general predictions of the theory. (M.J.T.)

30386 NEUTRON STARS AS A POSSIBLE SOURCE OF X-RAYS FROM OUTSIDE THE SOLAR SYSTEM. A. Finzi (Universita, Rome). Astrophys. J., 139: 1398-9(May 15, 1964).

It is hypothesized that observed cosmic x rays originate in neutron stars created in the gravitational collapse of the core of stars in supernovae outbursts. Calculations of the thermal energy content of a neutron star and of the heat flux through the external and intermediate shells of the star from models for a degenerate neutron gas are in reasonable agreement with values deduced from the energy of the observed x rays. (M.J.T.)

30387 EFFECTS OF DEVIATIONS FROM LOCAL THERMODYNAMIC EQUILIBRIUM ON SOLAR ABUNDANCES. Edith A. Mueller and J. Paul Mutschlecner (Univ. of Michigan, Ann Arbor). Astrophys. J., Suppl. Ser., 9: No. 85, 1-64(June 1964).

Investigations of center-to-limb variations of curves of growth were carried out in order to detect effects of deviations from local thermodynamic equilibrium on solar abundances. The neutral stages of the elements Ca, Ti, V, Cr, Mn, Fe, and Co were considered. For three positions on the solar disk, $\mu = 1.0$, 0.5, and 0.3, theoretical curves of growth were computed by the weighting-function method, employing a new semi-empirical solar model and new partition functions. The observed curves of growth were constructed with the most reliable f-values available and with equivalent widths measured on three solar spectrum atlases traced at the three values of μ. No systematic variation of the abundances from center to limb or from lower to higher excitation lines could be detected. This indicates that the assumption of local thermodynamic equilibrium does not introduce large errors in the solar abundances of the elements in the iron group. The high quality of the observational and theoretical data employed in this investigation should make possible reliable results for the abundances of the elements in the iron group. The choice of the absolute f-value scale is still very questionable, however, and completely trustworthy abundances cannot yet be obtained. (auth)

30388 ENERGETIC PARTICLES MEASURED NEAR VENUS BY MARINER 2. Hugh R. Anderson (Jet Propulsion Lab., Pasadena, Calif.). J. Geophys. Res., 69: 2651-7(July 1, 1964).

The rate of ionization and the omnidirectional flux of charged particle radiation near Venus were measured by an integrating ionization chamber and two Geiger-Müller counters. The instruments detected protons with $E \geq 10$ Mev and electrons with $E \geq 0.5$ Mev by direct penetration; lower-energy electrons were detected through the bremsstrahlung process. Mariner approached within 41,200 km of Venus' center, and no increase of radiation above the interplanetary level was measured. Upper limits to the increased fluxes of various species of particles in the vicinity of Venus are 0.04 penetrating particle/cm^2 sec, 1.3×10^5/cm^2 sec electrons with $E \simeq 40$ kev, or 8.0×10^3/cm^2 sec electrons with $E \simeq 100$ kev. It is concluded that no magnetosphere comparable to the earth's was penetrated. Assuming that dipole moments scale as the cube of the dimensions of the magnetosphere and that Venus' dipole moment is perpendicular to the plane of the ecliptic, Venus' moment was calculated to be no greater than 20% of that of the earth. (auth)

30389 A DIFFUSIVE MODEL FOR THE INITIAL PHASE OF A SOLAR PROTON EVENT. George C. Reid (National Bureau of Standards, Boulder, Colo.). J. Geophys. Res., 69: 2659-67(July 1, 1964).

According to one model, protons emitted by a flare diffuse through the solar atmosphere, gradually leaking off into the interplanetary field where they are stored for comparatively long periods. The early anisotropic phase of a solar proton event presumably represents the filling of the earth's local tube of force by this mechanism. An attempt is made to treat the diffusion through the solar atmosphere in a quantitative fashion, and the results are applied to measurements carried out by Explorer 12 on September 28, 1961. These data appear to fit the theory and permit a determination of the diffusion constant. Application of classical diffusion theory, though admittedly of dubious validity, yields a mean free path of about 600 km for protons of a few hundred Mev energy. (auth)

30390 HYDROMAGNETIC STABILITY OF THE MAGNETOSPHERIC BOUNDARY. S. P. Talwar (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res., 69: 2707-13(July 1, 1964).

The stability of the interface between the solar wind and the magnetosphere is investigated by means of hydromagnetic equations. An explicit criterion of instability is written for the special case in which both the solar plasma and the magnetospheric medium are supposed to be of the same density and carry a uniform magnetic field in the direction of streaming. It is concluded that the magnetospheric boundary is likely to be unstable toward the tail and under comparatively quiet solar conditions. (auth)

30391 COMMENT ON THE PAPER BY CONWAY W. SNYDER ET AL., "THE SOLAR WIND VELOCITY AND

ITS CORRELATION WITH COSMIC-RAY VARIATIONS AND WITH SOLAR AND GEOMAGNETIC ACTIVITY." Kemp Maer, Jr., and A. J. Dessler (Rice Univ., Houston, Tex.). J. Geophys. Res., 69: 2846(July 1, 1964).

On the basis of Mariner 2 data, Snyder showed that a positive relation exists between solar wind velocity and the geomagnetic index. The power-law relation proposed by Dessler is shown to fit the data rather well. (D.C.W.)

30392 THE STRENGTHS OF SPECTRUM LINES FORMED IN STELLAR ATMOSPHERES WITH PREDOMINANTLY H^- CONTINUOUS ABSORPTION. Brian Warner (London Univ.). J. Quant. Spectry. Radiative Transfer, 4: 415-26(May-June 1964).

The formulas for the equivalent widths of faint lines formed in a stellar atmosphere in which the continuous absorption coefficient is dominated by the H^- ion (corresponding to most F5-K5 stars) are developed. It is shown that for most atoms the formulas are particularly simple and, with plausible assumptions about the temperature distribution in the atmosphere, lead to a unique set of contribution functions. Using an approximate method of estimating the electron pressure as a function of depth, contribution functions for all atoms and ions can be calculated. Applications to both coarse and fine differential-abundance analyses are discussed; in particular, the difference in derived abundance between the two methods is evaluated. (auth)

30393 ENERGY SPECTRUM OF NEUTRINOS PRODUCED IN e^+, e^- PAIR ANNIHILATION. A. Masani (Osservatorio Astronomico, Milan and Centro di Astrofisica del CNR, Milan) and G. Silvestro. Nuovo Cimento (10), 32: 1217-25(June 1, 1964).

A calculation is made of the energy spectrum of neutrinos and antineutrinos produced in stars by electron-positron pair annihilation, on the basis of Feynman and Gell-Mann's theory of weak interactions, in the electron density range from 1.6×10^3 to 1.6×10^6 g/cm^3 and temperature range from 5×10^8 to 10^{10}°K. It is seen that the maximum of the neutrino spectrum ranges from 1.5 to 15 Mev. (auth)

30394 FLUX LIMITS FOR HIGH-ENERGY γ-RAYS FROM QUASI-STELLAR AND OTHER RADIO SOURCES. J. H. Fruin (Atomic Energy Research Establishment, Harwell, Berks, Eng.), J. V. Jelley, C. D. Long, N. A. Porter, and T. C. Weekes. Phys. Letters, 10: 176-7(June 1, 1964).

Limits to the gamma fluxes from the quasi-stellar sources 3C147, 3C196, 3C275; the Crab Nebula; and the magnetic variable 53 Cam were established by observation of light pulses from gamma-induced showers using a system of two Cherenkov light detectors in fast coincidences. (D.C.W.)

30395 ON OBSERVATIONS OF LUNAR MAGNETIC STORMS. Ann Palm and S. Silver (Univ. of California, Berkeley). Planetary Space Sci., 12: 649-50(June 1964).

Several types of magnetic disturbances are described in order to demonstrate possible differences between geomagnetic and selenomagnetic storms caused by identical solar events. Possibilities for investigating geomagnetic phenomena by lunar magnetometer and plasma-probe measurements, particularly in correlation with terrestrial magnetic measurements, are considered. (D.C.W.)

30396 THE NATURE OF SOLAR FLARES. H. Elliot (Imperial Coll. of Science and Tech., London). Planetary Space Sci., 12: 657-60(June 1964).

A flare model is discussed in which energetic protons are present under quiescent conditions in large numbers as trapped particles in the sunspot magnetic fields in the lower corona and the flare (optical emission) is the direct result of the catastrophic loss of these particles into the chromosphere. (D.C.W.)

30397 THE SOURCE OF SOLAR FLARES. James W. Warwick (Univ. of Colorado, Climax). Publ. Astron. Soc. Pacific, 74: 302-7(Aug. 1962).

The solar photosphere is considered as the source of solar flares by assuming that flares are produced by fast particles escaping into the solar atmosphere. The greatest depth in the photosphere from which a 300-Mev proton can emerge is calculated to be 480 km. The complex fields needed to accelerate particles to these energies can exist only in and below the photosphere. An examination of the possible energy sources available to solar flares (magnetic fields of atmosphere and hot flare gases) indicates that subphotospheric changes in current systems are probably responsible for flares. (auth)

30398 QUASI-STELLAR RADIO SOURCES. D. McNally (London Univ.). Sci. Progr. (London), 52: 426-33(July 1964).

The observation and properties of the quasi-stellar sources, particularly 3C48 and 3C273, are summarized; and some theories proposed for their properties are considered. (D.C.W.)

30399 NEUTRON AND PROTON DOSAGES IN THE UPPER ATMOSPHERE FROM SOLAR FLARE RADIATION. E. J. Flamm and R. E. Lingenfelter (Univ. of California, Los Angeles). Science, 144: 1566-9(June 26, 1964).

The radiation dosage from secondary neutrons as well as from primary and secondary protons in the earth's atmosphere during solar particle events was calculated as a function of the solar proton flux, atmospheric depth, and geomagnetic-cutoff rigidity. The dosage in rems from secondary neutrons exceeds the dosage from protons below 30 g/cm^2 of residual atmosphere. Neutron dosages in rads were less than the dosage from primary protons at all depths above 100 g/cm^2. The maximum neutron dose to travelers in supersonic aircraft during solar particle events of the magnitude observed during the last solar cycle would be of the order of 1 rem. (auth)

Atomic Physics

Refer also to abstract 30166.

30400 (LADC-5945) HARTREE SCATTERING FACTORS FOR ELEMENTS 37 THROUGH 98. Don T. Cromer, Allen C. Larson, and James T. Waber (Los Alamos Scientific Lab., N. Mex.). [1963]. Contract [W-7405-eng-36]. 23p.

Hartree scattering factors are given for atoms of atomic number 37 through 98 and for several of their ions. The values are listed in tabular form and as analytic functions. Values are also given for two low-lying excited states of cerium. Differences between the Hartree and Thomas-Fermi-Dirac scattering factors are discussed. (auth)

30401 (LADC-5950) BINDING ENERGY OF THE RELATIVISTIC THOMAS-FERMI ATOM. J. M. Canfield (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 5p.

Relativistic corrections to the total binding energy of free atoms in the statistical approximation are calculated by using the Gilvarry form of a relativistic Thomas-Fermi equation. It is found that the relativistic correction has the wrong sign to account for the small energy discrepancies discussed by previous investigators of the nonrelativistic case. (auth)

30402 (NASA-CR-68) PLANETARY PHYSICS. III. PHOTOIONIZATION CROSS SECTIONS OF THE RARE GASES. J. A. R. Samson and F. L. Kelley (Geophysics Corp. of America, Bedford, Mass.). July 1964. Contract NASw-840. 72p.

The absorption cross sections of He, Ne, Ar, Kr, and Xe were measured from the photoionization threshold down to 280 Å. The accuracy in the absolute value of the cross sections is estimated at ±5 percent and from 2 to 3 percent in the relative values. These results are compared to existing theories. Discrete structure is discussed due to excitation of inner shell electrons and their energy levels predicted where they as yet have not been observed. A table of critical absorption energies was compiled since no such table exists. A discussion of the oscillator strengths for transitions to the photoionization continuum is given for each of the rare gases. 62 references. (R.E.U.)

30403 (NP-14066) SPIN RELAXATION OF OPTICALLY PUMPED CESIUM (thesis). Frank A. Franz (Illinois. Univ., Urbana. Coordinated Science Lab.). Apr. 1964. Contract DA-36-039-AMC-92297(E). 105p. (R-202)

Spin relaxation of optically pumped cesium vapor was measured as a function of buffer gas pressure for various inert gases. Disorientation cross sections were found to be 5.3×10^{-24} cm^2 for neon, 8.0×10^{-23} cm^2 for argon, 2.1×10^{-21} cm^2 for krypton, and 4.6×10^{-20} cm^2 for xenon. The diffusion coefficients of cesium in neon and argon were found to be 0.40 and 0.23 cm^2/sec, respectively. Disorientation cross sections and diffusion coefficients were also determined for molecular nitrogen. The results are $\sigma = 4.7 \times 10^{-23}$ cm^2, $D_0 = 0.22$ cm^2/sec for $^{14}N_2$; $\sigma = 5.3 \times 10^{-23}$ cm^2, $D_0 = 0.20$ cm^2/sec for $^{15}N_2$. The agreement of these values with existing theory is discussed. A Fortran data reduction program for IBM 7094 is discussed. (auth)

30404 (TID-20760) COLLECTIVE EFFECTS IN ATOMIC SPECTRA. Werner Brandt (New York Univ., New York) and Stig Lundqvist (Chalmers Tekniska Hogskola, Goteborg). Apr. 1964. Contract AT(30-1)-1480. 26p.

The coupling between single-particle excitations of atoms is solved in the correspondence limit leading to a comprehensive formula for the atomic polarizability. From it the dipolar spectral distribution function $g(\omega)$ is derived for different frequency ranges of the atomic absorption spectrum. Many-electron coupling in outer-shell spectra can cause pronounced absorption peaks near and above the ionization edge. Collective resonances are expected for the atom as a whole at frequencies of order (atomic number) Ry. The coupling opens characteristically sharp windows in the spectral distribution function whenever single absorption lines are superimposed on a continuum. (auth)

30405 (UCRL-6987) CHARGE TRANSFER CROSS SECTIONS FOR H^+, H_2^+, OR H_3^+ ON H_2 FROM 2 TO 55 Kev. E. S. Chambers (California. Univ., Livermore. Lawrence Radiation Lab.). June 25, 1963. Contract W-7405-eng-48. 16p.

Charge-transfer cross sections of the hydrogen ions H^+, H_2^+, or H_3^+ on H_2 gas were obtained by measuring the fast neutrals produced. For H^+ on H_2, the maximum $\sigma_{10} = 8.3 \times 10^{-16}$ cm^2 at an ion energy of 7.5 kev. The results agree with previous work at all energies. For H_2^+ on H_2, the largest $\sigma_{10} = 7.3 \times 10^{-16}$ cm^2 is attained at the lowest energy observed. For H_3^+ on H_2, the maximum $\sigma_{10} = 5.5 \times 10^{-16}$ cm^2, at an ion energy of about 34 kev. Estimated accuracy is ±4%. The data can be correlated by plotting impulse exerted on an orbital electron of H_2 vs collision time. Previous data for H^+ on H are also treated for comparison. (auth)

30406 CROSSING OF ENERGY LEVELS WITH THE SAME M VALUE. R. Velasco and M. L. Dagher (Instituto de Optica (Daza de Valdes), Madrid). Anales Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 60: 9-12(Jan.-Feb. 1964).

In the course of a general study of perturbed Zeeman patterns a case was analyzed, which demonstrates experimentally the possibility of crossing of two energy levels with the same M-value. This unusual phenomenon occurs when the term z^4P of the Co atom is split by a magnetic field of 40,000 oersted or more. The magnetic levels $M = -1/2$ belonging to the atomic levels $z^4P_{0\frac{1}{2}}$ and $z^4P_{2\frac{1}{2}}$ actually cross as a result of the magnetic splitting. The validity of experimental "g" values obtained with strong magnetic fields is discussed. (auth)

30407 SCATTERING AMPLITUDES FOR ATOMIC COLLISIONS, WITH APPLICATION TO SPIN-EXCHANGE BETWEEN HYDROGEN ATOMS. A. E. Glassgold and S. A. Lebedeff (Univ. of California, Berkeley). Ann. Phys. (N. Y.), 28: 181-219(June 22, 1964). (BNL-7651)

Calculations of the scattering amplitudes for collisions between one-electron atoms are presented with emphasis on the scattering of two hydrogen atoms, including the spin-exchange process. The interaction between the atoms is represented by a potential $V_s(r)$. The corresponding scattering amplitudes f_s are obtained from exact (numerical) solutions of the radial Schrödinger equation. Detailed comparisons are made with various approximations, such as the JWKB method, the high-energy approximation to it, and the model of Purcell and Field and Wittke and Dicke. A phenomenological model for the unpolarized scattering is formulated. A detailed discussion, based on the exact calculations, is also given of various differential cross sections and of the energy dependence of the total cross sections. This includes the effects of the identity of the atoms and the occurrence of resonances. (auth)

30408 AN OPTICALLY PUMPED ^{87}Rb LASER OSCILLATOR. P. Davidovits (Columbia Univ., New York). Appl. Phys. Letters, 5: 15-16(July 1, 1964).

Laser oscillation in optically pumped ^{87}Rb was observed at the ^{87}Rb ground-state hyperfine transition frequency (~6835 Mcps). The ^{87}Rb and nitrogen buffer gas at 11 torr were contained in a glass cell designed to fit a microwave cavity operating in the TE_{011} mode. Laser gains of −4 to 6dB and an oscillator power output of about 10^{-11} w were obtained. (D.C.W.)

30409 A GENERAL DISCUSSION ON INELASTIC COLLISIONS OF ATOMS AND SIMPLE MOLECULES, 10TH-12TH APRIL, 1962. Discussions Faraday Soc., No. 33, 1-299(1962).

A separate abstract was prepared for one of the twenty-five papers included on the interactions and reactions of atoms and molecules and their results. Collision processes that involve and do not involve chemical reactions are both considered. Two other papers were previously abstracted in NSA (16: 24276 and 17: 8970). (D.C.W.)

For an abstract of the individual paper see: 30410.

30410 THREE-BODY COLLISION RATES IN ATOMIC RECOMBINATION REACTIONS. Felix T. Smith (Stanford Research Inst., Menlo Park, Calif.). Discussions Faraday Soc., No. 33, 183-8(1962).

A new symmetric representation for 3-body collisions is used to define the 3-body collision rate in terms of the masses and radii of the particles, and the temperature. Comparison with experiment shows that the reaction I + I + A → I_2 + A, with A a rare gas atom, has a collision efficiency between 1/720 for He and 1/44 for Xe. (auth)

30411 ELECTRON CAPTURE BY He^+ IONS PASSING THROUGH He ATOMS. D. M. Bhattacharya, S. C. Mukherjee, and N. C. Sil (Indian Assn. for the Cultivation of Science, Calcutta). Indian J. Phys., 37: 611-15(Dec. 1963).

The expression for the cross section of the electron capture by He^+ ions passing through normal He atoms was derived by applying a variational method. The effect of exchange of the electrons and the influence of their translatory motion on the cross section were taken into account. (auth)

30412 SOME MATHEMATICAL GENERALIZATIONS OF THE SCHRÖDINGER EQUATION FOR TWO-ELECTRON ATOMS. G. Kemeny (Kennecott Copper Corp., Lexington, Mass.) and Peter J. Walsh. J. Chem. Phys., 41: 81-4 (July 1, 1964).

Within the past few years, considerable success was found in using interelectron coordinates in atomic wavefunctions to describe atomic systems. A mathematical background is given for the generalization of this method for application to more complicated atomic, molecular, and solid systems. (auth)

30413 FRACTION OF H_2^+ IONS WHICH PRODUCE FREE PROTONS BY STRIKING A METAL SURFACE. A. W. Ehler (Hughes Research Labs., Malibu, Calif.). J. Chem. Phys., 41: 283(July 1, 1964).

The fraction of H_2^+ ions that produce free protons by striking a metal surface was measured for copper, aluminum, stainless steel, and carbon at impingement energies from 500 to 5500 v. Results are shown in diagram form. (M.C.G.)

30414 ULTRAMICROWAVE GENERATION BY CERENKOV INTERACTION WITH ELECTRON BEAMS. B. D. Nag Chaudhuri (Saha Inst. of Nuclear Physics, Calcutta). J. Inst. Telecommun. Engrs., 9: 281-5(1963).

The possibility of using Cherenkov interaction in ferrites by bunched electron beams to produce coherent power at microwave frequencies and higher was investigated. The conditions under which microwave power in the millimeter wave region can be generated with sufficient intensity and the necessary properties of the ferrite are discussed. (auth)

30415 ^{86}Kr VACUUM WAVELENGTHS. F. M. Phelps, III (Univ. of Alberta, Edmonton). J. Opt. Soc. Am., 54: 864-8(July 1964).

Precision measurements of vacuum wavelengths between 3425 and 6907 Å were made of 95 lines in the spectrum of ^{86}Kr from an Englehard-type lapm operated at the triple point of nitrogen. The accuracy obtained is of the order of 0.0001 Å. The wavenumbers computed from the experimental data are consistent to 1 mK or better. (auth)

30416 LIFETIMES OF EXCITATION LEVELS OF He ATOMS. Jozsef Bakos and Jonos Szigeti. Magy Tud. Akad. Kozp. Fiz. Kut. Int. Kozlemen., 12: 125-34(1964). (In Hungarian)

The lifetimes of the 4^3S and 4^1D excitation levels in He, as determined from decay curve measurements, were found to be 67.0 ± 1.4 and 41.6 ± 1.3 nsec, respectively. From individual mean life measurements on the excitation levels 3^3P, 5^1D, 4^3D, and 4^1S, the lifetime of these levels were found to be 118.6, 56.1, 97.0, and 91.5 nesc, respectively. (auth)

30417 MEASUREMENT OF EXCITATION LEVEL MEAN LIFE AND DECAY FOR ATOMS BY PULSED ELECTRON EXCITATION AND TIME ANALYSIS. Jozsef Bákos and János Szigeti. Magy. Tud. Akad. Kozp. Fiz. Kut. Int. Kozlemen., 12: 159-74(1964). (In Hungarian)

Making use of a time-to-pulse height converter and pulse-height analyzer an apparatus was developed for measuring atomic excitation level decay time and mean life. Design principles and the effects interfering with the measurement are discussed. Checking measurements are described and some results obtained for He are given. Considering the experimental errors, possible ways of improvement are contemplated. (auth)

30418 SPIN RELAXATION IN AN OPTICALLY ORIENTED SODIUM VAPOR. A. T. Ramsey and L. W. Anderson (Univ. of Wisconsin, Madison). Nuovo Cimento (10), 32: 1151-7(June 1, 1964).

The spin relaxation times of an optically oriented Na vapor diffusing in buffer gases of He, H_2, and N_2 were measured, and from these times the spin disorientation cross sections of atomic Na colliding with He, H_2, and N_2, and the mutual diffusion constants for Na in these gases were determined. The spin relaxation times of a Na vapor in mixtures of He and dilute amounts of Ar, Kr, and Xe were measured and the spin disorientation cross sections for Na colliding with Ar, Kr, and Xe were determined. The relaxation time of Na in He is used to set an upper limit on the nuclear electric dipole moment of ^{23}Na. (auth)

30419 COHERENT EXCITATION OF STATES BY ELECTRON IMPACT. E. G. Aleksandrov. Opt. Spectry. (USSR) (English Transl.), 16: 209-11(Mar. 1964).

A resonant increase in the degree of modulation of cadmium luminescence ($\lambda = 3261$ Å) excited by a modulated electron beam is observed when the modulation frequency coincides with the frequency of the transition between the $m = \pm 1$ levels of the $5\ ^3P_1$ state of cadmium in a magnetic field. The phenomenon is explained by the interference of the $m = \pm 1$ levels which arise as a result of coherent excitation. (auth)

30420 SEMIEMPIRICAL CALCULATION OF OSCILLATOR STRENGTHS FOR LITHIUM, RUBIDIUM, AND CESIUM ATOMS. E. M. Anderson and V. A. Zilitis. Opt. Spectry. (USSR) (English Transl.), 16: 211-14(Mar. 1964).

Numerical values of the oscillator strengths for the $ns \rightarrow mp$, $np \rightarrow md$, and $nd \rightarrow mf$ transitions in lithium, rubidium, and cesium atoms have been calculated by the method described in ref. 1. The calculations were carried out for transitions between states for which the energies are given in Moore's tables[2] for $n, m \leq 19$. (auth)

30421 ZEEMAN EFFECT OF THE PRINCIPAL EMISSION LINE IN A CaF_2-Tm^{2+} CRYSTAL. B. P. Zakharchenya, V. P. Makarov, A. V. Varfolomeev, and A. Ya Ryskin. Opt. Spectry. (USSR) (English Transl.), 16: 248-50(Mar. 1964).

The Zeeman splitting of the narrow intensive emission line at 1.116 μ in a CaF_2-Tm^{2+} crystal has been investigated both experimentally and theoretically. It has been found that the line results from the magnetic dipole transition $(^2F_{5/2})^2\Gamma_7 \rightarrow (^2F_{7/2})^2\Gamma_7$. (auth)

30422 STUDY OF THE LUMINESCENCE SPECTRA AND GENERATION OF VARIOUS CaF_2 CRYSTALS WITH U^{3+} IMPURITY IONS. P. A. Bazhulin, V. I. Malyshev, A. S. Markin, A. V. Rakov, and Kh. S. Bagdasarov. Opt. Spectry. (USSR) (English Transl.), 16: 291-2(Mar. 1964).

Observations of $\lambda = 2.5$ μ and 2.6 μ lines in the luminescence spectra of CaF_2-U^{3+} crystals at various temperatures are reported. The temperature dependence of the absolute and the relative intensity of the lines was measured for crystals with generation of one wavelength (2.5 or 2.6 μ) and of the two wavelengths simultaneously (mixed crystals). It is hypothesized from the identical character

of the temperature dependence for both crystals that the mixed crystals can be considered as mechanical mixtures of two forms of U^{3+} ions, with different symmetry, radiating independently of each other. Further study is made to verify this hypothesis. (L.B.S.)

30423 LUMINESCENCE OF TRIVALENT SAMARIUM IN NaCl AND KCl CRYSTALS. B. S. Skorobogatov, S. A. Sazonova, A. V. Dolgopolova, and L. V. Kovaleva. Opt. Spectry. (USSR) (English Transl.), 16: 292-3(Mar. 1964).

Three characteristic groups of lines were observed in the luminescence spectra of trivalent samarium ions in single crystals of sodium chloride at 77°, 300°, and 450°K. These are discussed and compared with the CaF_2-Sm^{3+} spectrum. The luminescence spectrum of $KCl-Sm^{3+}$ at 300°K shows three lines, coinciding in position with the fundamental luminescence lines in NaCl. (L.B.S.)

30424 ON THE DIFFERENCE BETWEEN "CLASSICAL" AND QUANTUM MECHANICAL COLLISION THEORIES. L. Vriens (Rijksuniversiteit, Utrecht). Phys. Letters, 10: 170-1(June 1, 1964).

The cross sections for excitation and ionization of atoms by electrons have different dependences on the incident electron energy E_1 in two-particle collision theory and quantum theory. Examination of the corresponding formulas in the two theories leads to the conclusion that the principal difference is due to the fact that the law of conservation of momentum gives different values of the minimum incident electron momentum for two-particle and multi-particle collisions and to the form of the differential cross section for momentum change in quantum theory. The impulse approximation is also concluded to be unreliable, as compared with the Born approximation, for large E_1. (D.C.W.)

30425 STUDY OF SPIN-EXCHANGE COLLISIONS IN VAPORS OF Rb^{85}, Rb^{87}, AND Cs^{133} BY PARAMAGNETIC RESONANCE. H. Warren Moos and Richard H. Sands (Univ. of Michigan, Ann Arbor). Phys. Rev., 135: A591-602(Aug. 3, 1964).

The effective spin-dephasing cross sections of ^{85}Rb, ^{87}Rb, and ^{133}Cs caused by spin-exchange collisions were measured using paramagnetic resonance techniques to examine the Zeeman transitions of these alkalis. The collision frequency was determined from the width of the absorption lines and the density of atoms by comparing the intensity of the signal with a $CuSO_4 \cdot 5H_2O$ crystal in the same cavity. The spin-dephasing cross sections of ^{85}Rb, ^{87}Rb, and ^{133}Cs are 2.0, 1.9, and 2.3×10^{-14} cm^2. The 70% probable error is ±20%. The relation of these measured dephasing cross sections to the spin-exchange cross sections is discussed. The thermal relaxation times were measured also; it was found that they were best explained by the strong exchange coupling that enhanced a relatively weak relaxation mechanism. (auth)

30426 SPECTRA INDUCED BY PROTON IMPACT ON HELIUM. J. G. Dodd and R. H. Hughes (Univ. of Arkansas Fayetteville). Phys. Rev., 135: A618-21(Aug. 3, 1964).

Spectra induced by proton impact on helium were studied in the energy range of 20 to 130 kev. Absolute cross sections were measured for helium emissions from $n\,^1S \rightarrow 2\,^1P(n = 3,4,5)$, $3\,^1P \rightarrow 2\,^1S$, and He II ($4 \rightarrow 3$) transitions. From these measurements cross sections were estimated for excitation into the $3\,^1P$, $3\,^1S$, $4\,^1S$, and $5\,^1S$ states, and for simultaneous ionization (including charge transfer) and excitation of helium into the $n = 4$ state of He^+. (auth)

30427 OPTICAL BREMSSTRAHLUNG AND TRANSITION RADIATION FROM IRRADIATED MEDIA. R. H. Ritchie, J. C. Ashley, and L. C. Emerson (Oak Ridge National Lab., Tenn.). Phys. Rev., 135: A759-63(Aug. 3, 1964).

A semiclassical theory is used to analyze the process by which light is generated when energetic electrons bombard a dielectric slab and undergo multiple scatter in its interior. The electrons are taken to be normally incident from vacuum upon a plane surface bounding the dielectric. Parameters characterizing the material are its complex dielectric permittivity $\epsilon(\omega)$ for light of frequency ω; $\sigma(\Theta)$, the cross section for scatter of an electron through an angle Θ in an encounter with a scattering center in the dielectric; and N, the density of scattering centers, which are taken to be randomly distributed throughout the medium. Light generated due to electric polarization induced in the medium (transition radiation) is considered together with that due to acceleration of the electron in scattering collisions. The distribution function of emitted light describes transition radiation, bremsstrahlung from multiple small-angle electron scattering, and interference between these two kinds of radiation. (auth)

30428 STRUCTURE OF THE SPECTRA OF DISORDERED SYSTEMS. Jun-ichi Hori (Hokkaido Univ., Sapporo). Progr. Theoret. Phys. (Kyoto), 31: 522-3 (Mar. 1964).

The explanation previously presented for the numerous distinct peaks in the vibrational frequency spectra of disordered diatomic lattices, in terms of the transfer-matrix, is extended to the vibrational spectra of disordered polyatomic lattices and the electronic energy spectra of the disordered Kronig-Penney model. Further, it is noted that the Saxon-Hutner theorem is valid for both cases and that the spectra may have fine peaks if the distributions of random parameters are discrete. (D.C.W.)

30429 EFFICIENCY OF A ^{85}Rb FILTER IN OPTICAL PUMPING OF ^{87}Rb. P. Davidovits and N. Knable (Columbia Univ., New York). Rev. Sci. Instr., 35: 857-8(July 1964).

The population of the $F = 2$ sublevels of the $^2S_{1/2}$ state of ^{87}Rb may be enhanced at the expense of the $F = 1$ levels by illuminating the ^{87}Rb with ^{87}Rb resonance radiation which is first passed through a ^{85}Rb cell, thus removing the component of light which stimulates transitions from the $F = 2$ levels. The effectiveness of the ^{85}Rb cell in transmitting the hyperfine line which produces population inversion while rejecting the depumping lines was measured. (auth)

30430 ANISOTROPY OF THE SPUTTERING RATIO AND OF THE ION-ELECTRON EMISSION COEFFICIENT IN SINGLE CRYSTALS. E. S. Maskova, V. A. Molchanov, and D. D. Odintsov (Moscow State Univ.). Soviet Phys. Solid State (English Transl.), 5: 2516-18(June 1964). Translated from Fiz. Tverd. Tela, 5: 3426-29(Dec. 1963).

Results are presented of measurements of the dependence of the sputtering ratio and the ion-electron emission coefficient for the (110) face of a Cu single crystal on the angle of incidence of 30-kev Ar ions during rotation around the [110] and [100] axes. The experimental curves are compared with curves calculated under the assumption that the secondary particle yield is determined by the energy transferred during the first collision near the surface and the probability of collision between the incident ions and lattice atoms. On the basis of the comparison of the experimental and calculated curves, it is concluded that for ions directed at a crystal at small angles of incidence, atomic layers below the tenth layer make a marked contribution to the sputtering ratio and the ion-electron emission coefficient. It is postulated that in the case of the ion-electron emission plasma waves are a possible mech-

anism of energy transfer from deep-seated layers to the surface. (auth)

30431 MAGNETIC AND ELECTRICAL PROPERTIES OF FERROELECTRIC YTTRIUM AND YTTERBIUM MANGANATES. V. A. Bokov, G. A. Smolenskii, S. A. Kizhaev, and I. E. Myl'nikova (Inst. for Semiconductors, Leningrad). Soviet Phys. Solid State (English Transl.), 5: 2646-7(June 1964). Translated from Fiz. Tverd. Tela, 5: 3607-9(Dec. 1963).

The electrical and magnetic properties of $YMnO_3$ and $YbMnO_3$ single crystals were measured. All the crystals exhibited a dielectric hysteresis loop. The temperature dependence of the permittivity was obtained at a frequency of 20 Mc, and the magnetic susceptibility was measured at temperatures from 77 to 950°K. The results show that both manganates are ferroelectric antiferromagnets with high ferroelectric curie points and low Neel points. (D.C.W.)

30432 CALCULATIONS OF ELECTRONIC WAVE FUNCTIONS IN THE RARE EARTH REGION. Ingvar Lindgren (Univ. of Uppsala). p.322-8 of "Perturbed Angular Correlations." Amsterdam, North-Holland Publishing Co., 1964.

The wave functions developed are discussed, together with the agreement with experiment of self-consistent-field calculations using the functions. The evaluation of $\langle r^{-3} \rangle$, which enters the determination of nuclear moments from hyperfine splittings, particularly, is considered. The corrections involved in the calculations and experimental checks on the calculations are also discussed. (D.C.W.)

30433 ATOMIC SELF-CONSISTENT FIELD CALCULATIONS BY THE EXPANSION METHOD. C. C. J. Roothaan and P. S. Bagus (Lockheed Missiles and Space Co., Palo Alto, Calif. and Univ. of Chicago). p.47-94 of "Methods in Computational Physics. Vol. II." New York, Academic Press, 1963.

The expansion method is extended for SCF calculations to include states which may have one open shell for each symmetry species. Equations for finding the determinant of the lowest total energy are derived. The digital computer program, written for the IBM 7090, is described. (L.B.S.)

Cosmic Radiation

Refer also to abstract 30032.

30434 (AD-415424) STUDY OF EXTENSIVE AIR SHOWERS AT 5200 m. ALTITUDE WITH SPECIAL RESPECT TO GAMMA-RAY SHOWERS. Final Technical Report. (Universidad Mayor de "San Andres," La Paz, Bolivia. Laboratorio de Fisica Cosmica de Chacaltaya). Oct. 1962. Contract AF49(638)-922. 58p.

The construction and installation of equipment on Mt. Chacaltaya for primary gamma-ray observations are described. Preliminary results are reported. A list of publications for the report period is given. (R.E.U.)

30435 (CONF-320-3) COSMIC-RAY EQUILIBRIUM. W. L. Kraushaar (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science). [nd]. Contract [AT(30-1)-2098]. 4p.

From the International Conference on Cosmic Rays, Jaipur, India, Dec. 1963.

Particle acceleration mechanisms were studied for astronomical systems from which radio noise, interpreted as synchrotron radiation by electrons made in heavy particle (proton) collision processes, emanates. The Fermi form of the energy spectrum, $KE^{-\gamma}dE$ with $\gamma = 1 + (\alpha T)^{-2}$ where α appears in the energy gain $dE/dt = \alpha E$ and T is a characteristic leakage time, is considered. (R.E.U.)

30436 (CONF-320-4) COSMIC GAMMA-RAY RESULTS FROM EXPLORER XI. W. L. Kraushaar, G. W. Clark, M. Agagino, G. Garmire, H. Helmken, and P. Higbie (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science). [1963]. Contract [AT(30-1)-2098]. 8p.

From the International Conference on Cosmic Rays, Jaipur, India, Dec. 1963.

A directional analysis of gamma arrivals relative to the earth is presented. (R.E.U.)

30437 (CONF-320-6) THE PRIMARY ENERGY SPECTRUM FROM 6×10^{14} ev TO 4×10^{17} ev. G. Clark, H. Bradt, M. La Pointe (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science); V. Domingo, I. Escobar, K. Murakami, K. Suga, Y. Toyoda, and J. Hersil (Universidad Mayor de "San Andres," La Paz, Bolivia. Laboratorio de Fisica Cosmica de Chacaltaya). [1962]. Contract [AT(30-1)-2098]. 11p.

From the International Conference on Cosmic Rays, Jaipur, India, Dec. 1963.

The determination of the primary energy spectrum of cosmic rays from air shower data is discussed. (R.E.U.)

30438 (INSJ-69) EMULSION CHAMBER PROJECT OF JAPAN-BRAZIL COLLABORATION. (Tokyo Univ. Inst. for Nuclear Study). Apr. 2, 1964. 26p.

Results are given for emulsion chamber studies of high-energy gamma rays and nuclear interactions from exposures at Mt. Chacaltaya (5200 m) and Mt. Norikura (2800 m). The chamber was a multiple sandwich of lead plates with Fuji ETFA nuclear emulsion plates and Sakura N-type x ray film. (R.E.U.)

30439 (NASA-TT-F-127) COSMIC RAYS. S. N. Vernov and L. I. Dorman, eds. Translation of "Kosmicheskiye Luchi," from IGY Program, Section VII, No. 4, Izdatel'stvo Akademii Nauk SSSR, Moscow, 1961. 390p.

Separate abstracts were prepared for the 25 papers included. Cosmic-ray intensities prior to and during magnetic disturbances and their variations as obtained through the worldwide network of IGY stations are discussed. (R.E.U.)

For abstracts of individual papers see: 30440, 30441, 30442, 30443, 30444, 30445, 30446, 30447, 30448, 30449, 30450, 30451, 30452, 30453, 30454, 30455, 30456, 30457, 30458, 30459, 30460, 30461, 30462, 30463, and 30464.

30440 (NASA-TT-F-127(p.2-23)) NATURE OF THE INCREASE IN COSMIC-RAY INTENSITY AT A FORBUSH-EFFECT MINIMUM. L. I. Dorman, Ya. L. Blokh, and N. S. Kaminer. (A translation)

A collection is presented of information that is used to explain the increase in cosmic-ray intensity at a Forbush-effect minimum during the main phase of a geomagnetic storm. 16 references. (R.E.U.)

30441 (NASA-TT-F-127(p.24-40)) ENERGY CHARACTERISTICS OF COSMIC-RAY VARIATIONS DURING MAGNETIC DISTURBANCES. A. I. Kuz'min, A. A. Danilov, G. F. Krymskii, and G. V. Skripin. (A translation)

Intensity decreases of cosmic particles during geomagnetic storms were observed over a two-year period and are reported. (R.E.U.)

30442 (NASA-TT-F-127(p.41-7)) ON COSMIC-RAY EFFECTS— THE FORERUNNERS OF MAGNETIC

STORMS. Ya. L. Blokh, N. S. Kaminer, and L. I. Dorman. (A translation)

The effects of the magnetized shock front of a corpuscular stream on cosmic rays were studied. This complex action results in effects detectable prior to the onset of a geomagnetic storm. (R.E.U.)

30443 (NASA-TT-F-127(p.48-51)) ON THE EMISSION TIME AND ANGULAR WIDTH OF SOLAR CORPUSCULAR STREAMS. N. S. Kaminer, Ya. L. Blokh, and L. I. Dorman. (A translation)

Determination of the angular width of solar corpuscular radiation from the duration of Forbush effects and emission time (continuous or not) of corpuscular streams are discussed. (R.E.U.)

30444 (NASA-TT-F-127(p.52-72)) INVESTIGATION OF VARIATIONS OF COSMIC-RAY INTENSITY, THE EARTH'S MAGNETIC FIELD, AND AURORAS DURING THE MAGNETIC STORM OF 25 MARCH 1958. E. (Ye.) V. Kolomeyets, G. A. Sergeyeva, and K. F. Tarasova. (A translation)

The energy spectrum of the primary variation was computed, the diurnal variation of the neutron component was analyzed, and several characteristic features of the magnetic storm effect were found. (R.E.U.)

30445 (NASA-TT-F-127(p.73-88)) THE PROBLEM OF THE NATURE OF THE PREDECREASES OF COSMIC-RAY INTENSITY PRIOR TO MAGNETIC STORMS. L. I. Dorman, N. S. Kaminer, and Ya. L. Blokh. (A translation)

An explanation is presented of the decreases in cosmic-ray intensity prior to the onset of geomagnetic storms accompanied by Forbush effects. (R.E.U.)

30446 (NASA-TT-F-127(p.89-131)) THE MAGNETIC STORM IN MID-MAY 1959 AND THE VARIATIONS OF COSMIC RAYS. N. S. Kaminer, L. I. Dorman, and Ya. L. Blokh. (A translation)

Worldwide cosmic-ray station data were used to investigate phenomena associated with the chromospheric flare of May 10, 1959, and observed in the geomagnetic field, in the upper atmosphere, and in cosmic rays. (R.E.U.)

30447 (NASA-TT-F-127(p.132-50)) THE SUPERPOSITION OF FORBUSH EFFECTS IN JULY 1959. Ya. L. Blokh, L. I. Dorman, and N. S. Kaminer. (A translation)

The superposition of cosmic-ray intensity-decrease effects, owing to the simultaneous action of several corpuscular streams was studied in July 1959 during periods of solar activity and associated geomagnetic disturbances. Worldwide cosmic-ray station data were used. (R.E.U.)

30448 (NASA-TT-F-127(p.151-98)) THE PROBLEM OF THE EFFECT ON COSMIC RAYS OF A SOLAR CORPUSCULAR STREAM IN THE FORM OF A MAGNETIZED ENVELOPE. L. I. Dorman. (A translation)

Piddington's magnetic core model of the interplanetary magnetic field, the spectrum of particles penetrating an infinite plane-parallel magnetic layer, envelope expansion, particle absorption by planets inside envelope, particle penetration of the envelope, and other factors that affect cosmic-ray variations due to the magnetized envelope are evaluated. (R.E.U.)

30449 (NASA-TT-F-127(p.199-207)) THE EARTH AS A COSMIC-RAY ABSORBER AND ITS ROLE IN THE CREATION OF FORBUSH-TYPE EFFECTS AND 27-DAY AND 11-YEAR VARIATIONS. L. I. Dorman. (A translation)

Particle diffusion and scattering are considered with variations in the circumterrestrial medium. (R.E.U.)

30450 (NASA-TT-F-127(p.208-12)) ON THE COSMIC-RAY VARIATIONS CAUSED BY AN EXPANDING TURBULENT MAGNETIZED CLOUD. L. I. Dorman. (A translation)

Cosmic-ray variations that may be caused on earth by an expanding turbulent cloud moving in a direction away from the sun for the case when the earth is inside the cloud are investigated. (R.E.U.)

30451 (NASA-TT-F-127(p.213-22)) STUDY OF THE EFFECT OF SMALL SOLAR FLARES ON THE INTENSITY OF THE NEUTRON COMPONENT OF COSMIC RAYS. E. (Ye.) V. Kolomeyets and G. A. Sergeyeva. (A translation)

The method of superposed epochs was used to analyze the two-hour values of neutron intensity for 60 solar flares of importance 2 and higher. Daytime and nighttime variations were recorded. (R.E.U.)

30452 (NASA-TT-F-127(p.223-34)) ON THE RELATIONSHIP BETWEEN SHORT-PERIOD PULSATIONS OF THE EARTH'S MAGNETIC FIELD AND THE INCREASE OF COSMIC-RAY INTENSITY IN THE STRATOSPHERE. V. A. Troitskaya. (A translation)

The results of a study of the relation between bursts of cosmic-ray intensity in the stratosphere and characteristic rapid pearl-type pulsations and short irregular pulsations are reported. (R.E.U.)

30453 (NASA-TT-F-127(p.235-66)) THE COSMIC-RAY BURST OF 4 MAY 1960. N. S. Kaminer, Ya. L. Blokh, and L. I. Dorman. (A translation)

Data from stations of the worldwide network are used to present an analysis of the distribution of incidence zones, the angular dimensions of the source of solar particles and their time variations, the solar-particle energy spectrum, and of data from other large cosmic-ray bursts. (R.E.U.)

30454 (NASA-TT-F-127(p.267-73)) SUDDEN INCREASES IN COSMIC-RAY INTENSITY CONNECTED WITH CORPUSCULAR STREAMS AND WITH ELECTROMAGNETIC CONDITIONS IN INTERPLANETARY SPACE AND IN THE VICINITY OF THE EARTH. L. I. Dorman. (A translation)

Increases in cosmic-ray intensity associated with solar flares are discussed. The magnetic fields of the corpuscular streams in interplanetary space are considered. (R.E.U.)

30455 (NASA-TT-F-127(p.274-80)) ON THE 27-DAY VARIATIONS OF COSMIC RAYS IN THE STRATOSPHERE DURING THE PERIOD BETWEEN JULY 1957 AND FEBRUARY 1958. A. N. Charakhch'yan, V. F. Tulinov, and T. N. Charakhch'yan. (A translation)

Experimental verification is presented for 27-day variations of cosmic rays in the stratosphere. Periodgrams are shown. (R.E.U.)

30456 (NASA-TT-F-127(p.281-311)) INVESTIGATION OF THE 27-DAY VARIATIONS OF COSMIC RAYS ACCORDING TO DATA FROM THE WORLDWIDE NETWORK OF IGY STATIONS FOR THE PERIOD JULY TO DECEMBER 1957. L. I. Dorman and L. Kh. Shatashvili. (A translation)

Experimental verification is presented for 27-day variations in cosmic rays from worldwide network stations during IGY. The 27-day period of synodic rotation of active regions of the sun is considered. (R.E.U.)

30457 (NASA-TT-F-127(p.312-14)) 27-DAY RECURRENCE TENDENCY IN HARD-COMPONENT INTENSITY DURING A SOLAR-ACTIVITY MINIMUM ACCORDING TO OBSERVATIONS IN TBILISI. A. M. Chketiya and L. Kh. Shatashvili. (A translation)

Data from Tbilisi for 1954 indicate that the 27-day recurrence tendency for cosmic rays is associated with solar activity. (R.E.U.)

30458 (NASA-TT-F-127(p.315-20)) ON COSMIC-RAY VARIATIONS DUE TO AN ASYMMETRIC SOLAR WIND. L. I. Dorman. (A translation)

The asymmetry in solar wind from distributions of active regions of the sun is studied from its effects on cosmic radiation reaching the earth. Particle densities are formulated. (R.E.U.)

30459 (NASA-TT-F-127(p.321-45)) EXPERIMENTS WITH CROSSED TELESCOPES AND THE NATURE OF THE SOLAR DIURNAL VARIATION OF COSMIC RAYS DURING A SOLAR MAXIMUM AND A SOLAR MINIMUM. L. I. Dorman and O. I. Inozemtseva. (A translation)

Observations of cosmic-ray variations with crossed telescopes were studied to determine atmospheric causes for the solar diurnal variation from east and west, and north and south. (R.E.U.)

30460 (NASA-TT-F-127(p.346-51)) THE QUESTION OF THE SIDEREAL DIURNAL EFFECT IN COSMIC RAYS DURING 1954. E. (Ye.) S. Glokova. (A translation)

The apparent sidereal diurnal variation in the hard component of cosmic rays during 1954 was studied from the variation in phase of the solar diurnal vector. (R.E.U.)

30461 (NASA-TT-F-127(p.352-63)) CERTAIN PROPERTIES OF THE SOLAR DIURNAL VARIATION. (From Material on Directional Measurements of Cosmic Rays Below Ground). G. V. Skripin. (A translation)

Results are presented of directional diurnal variation measurements obtained in 1958-59 at ground level and at depths of 7, 20, and 60 Mwe. Counter telescope results for high-energy primaries varied for south and north orientations; the variation is attributed to an effect of the geomagnetic field on the particle trajectories. (R.E.U.)

30462 (NASA-TT-F-127(p.364-82)) THE NATURE OF DISTURBANCES IN THE DIURNAL VARIATION OF COSMIC RAYS APPROACHING THE EARTH FROM DIFFERENT DIRECTIONS DURING MAGNETIC STORMS. L. I. Dorman and O. I. Inozemtseva. (A translation)

An analysis is given of data showing the relation between the diurnal variation of cosmic rays and the direction of approach of the primary particles during geomagnetic disturbances. The method of superposed epochs and elimination of spurious diurnal variations were used. It is shown that for both north and south directions and for particles approaching vertically, a regular phase shift in the diurnal variations toward earlier hours is observed during magnetic disturbances following the onset of a storm. (R.E.U.)

30463 (NASA-TT-F-127(p.383-6)) THE PROBLEM OF THE NATURE OF THE SOURCE OF THE DIURNAL VARIATION OF COSMIC RAYS FROM THE DIRECTION OF THE SUN. L. I. Dorman. (A translation)

Cosmic-ray anisotropy due to radial drift velocity of particles in the stream plasma from the sun is considered. (R.E.U.)

30464 (NASA-TT-F-127(p.387-90)) THE NATURE OF THE LUNAR DIURNAL VARIATION OF COSMIC RAYS. L. I. Dorman. (A translation)

Some difficulties in the investigation of the variation of cosmic-ray intensity with a period of one lunar day and an amplitude of 0.1 to 0.2% are discussed. The shadow effect caused by magnetic fields is considered. (R.E.U.)

30465 DISCUSSION OF A PAPER BY D. J. HOFMANN AND J. R. WINCKLER, "SIMULTANEOUS BALLOON OBSERVATIONS AT FORT CHURCHILL AND MINNEAPOLIS DURING THE SOLAR COSMIC RAY EVENTS OF JULY 1961." S. M. Bennett (AVCO Corp., Wilmington, Mass.). J. Geophys. Res., 69: 2843-4(July 1, 1964).

Discrepancies in the use of a power law decay and the diffusion model to interpret data on the cosmic events of July 18 and 20, 1961, are indicated. (D.C.W.)

30466 D REGION ELECTRON DENSITY PROFILES DURING AURORAS. G. M. Lerfald (National Bureau of Standards, Boulder, Colo.), C. G. Little, and R. Parthasarathy. J. Geophys. Res., 69: 2857-60(July 1, 1964).

The preliminary results of an analysis of multi-frequency cosmic noise absorption data taken during auroral absorption events at College, Alaska, are presented. (D.C.W.)

30467 ON THE ANGULAR MOMENTUM OF THE TOTAL SYSTEM OF SECONDARY PARTICLES IN A JET SHOWER. Takaichi Kawamura (Nagoya Univ., Japan). Progr. Theoret. Phys. (Kyoto), 31: 518-19(Mar. 1964).

The angular momentum of the secondary particles of a jet shower in a cosmic event is calculated from the angular distribution of the secondary particles by applying quantum mechanics to secondary particles that behave almost like free particles. (D.C.W.)

30468 SOME NEW WAYS OF LOOKING AT COSMIC RAYS. G. W. Hutchinson (Univ. of Southampton, Eng.). Sci. Progr. (London), 52: 386-405(July 1964).

The basic knowledge of cosmic radiation is summarized, and the cosmic and galactic implications of their origin and transmission to earth are discussed. Solar effects on cosmic radiation, very-high-energy rays, source regions, production, and temporal variations are considered, together with experimental methods and trends. (D.C.W.)

30469 ON THE LONGITUDINAL DISTRIBUTION OF ELECTRONS IN EXTENSIVE AIR SHOWERS. R. Thielert and L. Wiedecke (Universität, Kiel). Z. Physik, 179: 199-212(1964). (In German)

The standard deviation σ of the instantaneous distribution of electrons in extensive air showers at sea level was measured by coincidence of two spark counters, a cloud chamber providing data on arrival directions, and particle densities. The values published previously were in the range $2 < \sigma < 8$ ns and the standard time deviation σ_0 due to instrumental fluctuations was about 4 ns. In this experiment with a $\sigma_0 = 1.8$ ns mean delays, σ, were obtained between 1 and 2 ns, the values decreasing with increasing particle density. This tendency may be due to the fact that the mean separations of the electrons, taken perpendicular to the shower front, increase with distance from the shower axis. The fractional contribution of showers within a given range of sizes, the axes of which came down within a given interval of distances from the counters was calculated. It was concluded that 80% of the showers triggering the two counters were in the range from 10^5 to 10^7 particles. By means of these calculations, using the measured values for the mean delays σ at different particle densities, a curve was constructed, which gives the mean separations of electrons vs distance from the shower axis up to 1000 m and is in good agreement with the experimental data of Linsley and Scarsi for great distances from the shower axis. (auth)

30470 RELATIVE TIME DELAYS BETWEEN COINCIDENT COSMIC-RAY PARTICLES AT SMALL DETECTOR DISTANCES. E. Boehm, R. Thielert, and L. Wiedecke (Universität, Kiel). Z. Physik, 179: 213-20(1964). (In German)

The distribution of arrival times of cosmic particles were investigated with two spark counters (horizontal sep-

aration 20 cm) and an auxiliary layer of Geiger-Mueller counters. The standard time deviation due to instrumental fluctuations was $\sigma_0 = 1.8$ ns. Mean time delays of $\sigma = 17$ ns, as measured by Robinson, were not detected. Mean delays of 2.0 to 2.5 ns were due to extensive air showers, which gave varying contributions up to 25% of the counting rates in different runs, depending on absorber thickness above the apparatus. The major part of the events was of small lateral extension; their mean time delay vanished within the limits of experimental error. (auth)

Criticality Studies

30471 (ORNL-TM-868) CRITICAL THREE-DIMENSIONAL ARRAYS OF NEUTRON-INTERACTING UNITS. PART II. U(93.2) METAL. J. T. Thomas (Oak Ridge National Lab., Tenn.). July 1964. Contract W-7405-eng-26. 33p.

Criticality studies were made of three-dimensional arrays of uranium metal cylinders enriched to 93.2 wt % ^{235}U. Four weight groups of units, ranging from 10.5 to 26.2 kg of uranium in five sizes, were employed to determine the critical surface separation between units as a function of the number in an array. The critical uranium density (the ratio of the mass of a unit to the volume of the lattice cell it occupies in a critical array) was observed to depend upon a number of factors. Changes in k_{eff} of the individual units, caused by altering their shape, produced inverse changes in the density, provided the array shape was unchanged. The density of the array varied with its shape in a manner similar to that resulting from corresponding changes in a single critical unit. Addition of an hydrogenous reflector reduced the density of the array by factors much greater than those observed for similar reflection of a single critical unit. The density was found to be minimal when the units were separated by an hydrogenous moderator 4.9-cm thick. The separate effects of moderation and reflection of arrays are not additive. In several experiments it was observed that an array comprised of one-half of each of two different critical arrays was subcritical. Part I of the study is ORNL-TM-719. (auth)

Direct Energy Conversion

30472 (AD-427774) RESEARCH PROGRAM ON CLOSED-CYCLE MAGNETOPLASMADYNAMIC ELECTRICAL POWER GENERATION WITH NON-EQUILIBRIUM IONIZATION. Interim Scientific Report. (Martin-Marietta Corp. Aerospace Div., Baltimore). Dec. 31, 1963. Contract Nonr-3866(00). 7p.

One of the primary objectives was to demonstrate experimentally the principle of magnetically induced non-equilibrium ionization under actual closed-cycle magnetoplasmadynamic generator operating conditions. Data are presented, obtained during recent runs, which are of great scientific value since they experimentally prove for the first time the presence of magnetically induced nonequilibrium ionization. These runs were made with helium gas seeded with cesium under closed-cycle magnetoplasmadynamic generator operating conditions. The gas temperatures during these runs were varied from about 800 to 870°K, and in each case the effective electric conductivities measured whenever the magnetic field was on were over two orders of magnitude higher than the gas conductivities that could have possibly been attained by thermal equilibrium ionization alone. (auth)

30473 (AD-427870) INVESTIGATION OF NON-EQUILIBRIUM IONIZATION FOR MHD ENERGY CONVERSION. Quarterly Report No. 7, September 15–December 15, 1963. B. Hoffman (General Electric Co. Missile and Space Div., Valley Forge Space Technology Center, King of Prussia, Penna.). Contract AF33(657)-8298. 56p.

A research program directed toward prolonging the lifetime of MHD energy converters to the range 1000 to 2000°K is reported. The process of interest is the use of the self-induced electric field in MHD generator for electrical breakdown of appropriate working fluids of interest. Work is directed toward the use of potassium for Rankine (vapor) cycles. The potassium vapor blowdown system reached operational capability. Argon blowdown shakedown runs are underway to determine the dynamic behavior of the system. Design of the Rankine-cycle alkali-metal-vapor facility was completed. A mathematically consistent model for the transport of electrons in a wet vapor was formulated. A complete set of equations was obtained to describe the electrical conductivity of a wet vapor as a function of the fluid pressure, temperature, and flow velocity, the external electromagnetic fields, the percent moisture, and the droplet radius. (auth)

30474 (AD-428884) THE DEVELOPMENT OF A LOW-TEMPERATURE VAPOR-FILLED THERMIONIC CONVERTER FOR NUCLEAR APPLICATIONS. Summary Technical Report, May 28, 1962–January 30, 1963. G. Y. Eastman, W. E. Harbaugh, R. J. Buzzard (Radio Corp. of America. Electron Tube Div., Lancaster, Penna.); W. L. Orr, H. J. Worsham, and R. M. Ball (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). Apr. 1963. Contract NObs 84823. 185p.

As part of the program for the development of a reliable vapor-filled thermionic converter for use with a nuclear heat source, a series of inpile experiments was conducted. The program consisted of two phases. The first phase was a series of in-pile heat-transfer experiments in which a nuclear-fueled emitter was operated at the temperatures and heat flux required by the thermionic converter. Emitter temperature distribution data with electrical and nuclear heat sources were similar. No temperature perturbations were introduced by the nuclear fuel. The second phase was the successful inpile operation of the RCA Converter, Type A-1197A, for 300 hours in the Lynchburg Pool Reactor. A maximum electrical power output of 155 watts was produced at a computed efficiency of 10.3%. (auth)

30475 (AFCRL-63-940) RESEARCH IN ENERGY CONVERSION. Final Report. (Northeastern Univ., Boston). Nov. 22, 1963. Contract AF19(604)-7358. 304p. (AD-429505)

The research reported may be considered to fall into four broad areas of energy conversion, viz. photovoltaic, thermoelectric, thermionic, and photochemical phenomena. Studies were performed on: techniques for fabricating single crystals for solar energy converters; physicochemical properties related to semiconduction; the photochemical properties of selected systems; and plasma-based devices. (auth)

30476 (ARA-T-9159-3) STUDY OF MATERIALS FOR THERMIONIC CONVERTERS. Final Report. Harold Homonoff and Stanley Ruby (Allied Research Associates, Inc., Concord, Mass.). Dec. 31, 1963. Contract Nonr-3385(00). 40p. (AD-428003)

A study of materials for thermionic converters is carried out, with emphasis upon the solid-state factors that influence the work function (and its temperature coefficient) of metals, semiconductors, and insulators. Also, since the thermionic constants of emitter and collectors were seen to be critically dependent on the environment in

which they operate, an investigation was made of the electronic interactions involved at the electrode interfaces and the subsequent changes in work function that could be expected as a result of adsorption on a surface of partially complete monomolecular films. Knowledge of the solid-state properties of thermionic electrode materials and their surfaces is necessary in order to obtain long-lived low-work-function collectors operating in an environment that may consist of cesium at a pressure as high as 3.5 torr, tungsten vapor condensing on the collector at the rate of 5.0×10^{-14} g/cm^2/sec, and selective additives that help keep the collector surface in a continuous and highly activated state during the operation of the device. (auth)

30477 (BAW-1261) A SUMMARY REPORT OF THE USE OF THERMIONIC CONVERTERS IN A NATURAL CIRCULATION BOILING WATER REACTOR. W. L. Orr (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). July 1962. For Radio Corp. of America. [Special Electronic Components Div., Lancaster, Penna.]. Contract NOBS-84823, Subcontract G9-137924-H18. 50p. (AD-428883)

Studies made concerning the use of thermionic converters in a natural-circulation, boiling-water reactor are presented. The first two phases of the study were concerned with the reactivity available with Plasma-Triode and Ball-of-Fire converters. The third phase included a nuclear parameter study of two pressure tube concepts using the Ball-of-Fire converter. The conceptual design of a 1-Mw(e) natural-circulation thermionic reactor was developed using a pressure tube fuel element concept. (auth)

30478 (BAW-1267) SUMMARY REPORT OF THERMIONIC CONVERTER IN-PILE EXPERIMENTS. W. L. Orr, H. J. Worsham, and R. M. Ball (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). Mar. 1963. For Radio Corp. of America. [Special Electronic Components Div., Lancaster, Penna.]. Contract NObs-84823, Subcontract G9-137924-H18. 177p. (AD-428882)

As part of the program for the development of a reliable vapor-filled thermionic converter for use with a nuclear heat source, a series of in-pile experiments was conducted. The in-pile experimental program consisted of two phases. The first phase was a series of in-pile heat transfer experiments in which a nuclear-fueled emitter was operated at the temperatures and heat flux required by the thermionic converter. Emitter temperature distribution data with electrical and nuclear heat sources were similar. No adverse temperature perturbations were introduced by the nuclear fuel. The second phase was the successful in-pile operation of the RCA Converter Type A-1197A, for 300 hours in the Lynchburg Pool Reactor. A maximum electrical power output of 155 watts (2.58 watts/sq. cm) was produced at a computed efficiency of 10.3%. (auth)

30479 (DRI-2137) INVESTIGATION OF THE CHARACTERISTICS OF INTERMETALLIC COMPOUNDS AS THERMIONIC EMITTERS. Final Technical Summary Report. C. B. Magee, M. J. Pool, W. D. McMullen, R. C. Jerner, and R. H. Cox (Denver. Univ. Denver Research Inst.). Dec. 31, 1963. Contract NONR-3361(01). 56p. (AD-428591)

The evaporation rates of twelve intermetallic beryllides and beryllium have been measured in the temperature range from 900 to 1200°C, using the Langmuir free evaporation technique. The beryllides studies were $ZrBe_{13}$, Zr_2Be_{17}, $ZrBe_5$, $ZrBe_2$, $NbBe_{12}$, Nb_2Be_{17}, $NbBe_3$, $NbBe_2$, $TaBe_{12}$, Ta_2Be_{17}, $TaBe_3$, and $TaBe_2$. Representative results are listed for three temperatures. Evaporation rates are given in mg/sq cm/day. (auth)

30480 (MND-3127) RESEARCH PROGRAM ON CLOSED-CYCLE MAGNETOPLASMADYNAMIC ELECTRICAL POWER GENERATION WITH NONEQUILIBRIUM IONIZATION. Semi-annual Technical Summary Report, June 15, 1963–December 15, 1963. (Martin-Marietta Corp. Aerospace Div., Baltimore). Feb. 1964. Contract Nonr-3866(00). 64p. (AD-430548)

The objective of this program is to demonstrate the feasibility of non-equilibrium ionization as a means of effectively increasing the conductivity of the working fluid in a magnetoplasmadynamic (MPD) power generator. Non-equilibrium ionization is the only practical method of achieving high output-power densities at gas temperatures suitable for long-life operation. In support of the experimental part of this program and to guide in the selection of experimental conditions, two programs are being carried out, one involving the process of non-equilibrium ionization, and the other involving the study and analysis of closed-cycle MPD power generation under conditions compatible with the utilization of non-equilibrium ionization in a MPD duct. (auth)

30481 (NASA-TN-D-2357) THEORETICAL STUDY OF ZERO-FIELD ELECTRON WORK FUNCTION OF METAL IMMERSED IN GAS—DIRECT APPLICATION TO CESIUM THERMIONIC DIODE. Keung P. Luke and John R. Smith (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). July 1964. 66p.

It is well known that adsorbed gas on a metal surface can change significantly the electron work function of that metal. This phenomenon is of great importance in the field of gaseous thermionic energy conversion. In an effort to obtain an analytic relation that can predict quantitatively this phenomenon, the variation in the zero-field electron work function of a metal immersed in a gas is studied. This study begins with a general consideration of the dipole moment, the effective polarizability, the mutual interaction energy, and the desorption rate of a system of gas particles adsorbed on a metal surface. With the aid of several simplifying assumptions, two equations are then derived that relate the change in the zero-field electron work function of the metal to its surface temperature and the gas pressure and temperature. As an example, the change in the zero-field electron work function of tungsten immersed in a cesium vapor $\Delta\varphi_e$ is computed and plotted against the ratio of the tungsten surface temperature to the cesium reservoir temperature at cesium reservoir temperatures of 300, 400, 470, 473, 500, and 600°K. It is found that the computed values of $\Delta\varphi_e$ at 470, 473, and 500°K fit very well the experimental data of Houston and of Breitwieser on the cesium-tungsten system at the corresponding cesium reservoir temperatures. (auth)

30482 (R64SD-5) LINEARIZED ANALYSIS OF MHD GENERATOR FLOW STABILITY. George W. Sutton and Erik Witalis (General Electric Co. Missile and Space Div., Valley Forge Space Technology Center, King of Prussia, Penna.). Jan. 1964. Contract AF49(638)-914. 11p. (AD-429173)

The quasi one-dimensional compressible flow equations for a magnetohydrodynamic power generator were analyzed for one-dimensional instabilities by means of linearized perturbations. The gas was assumed to be ideally compressible, inviscid, nonheat-conducting, with an electrical conductivity that depends on local temperature. The results indicate that large instabilities cannot exist, confirming the previous approximate results of Wright and refuting the original claims of Velikhov. (auth)

30483 (TID-7687) A SYMPOSIUM ON HIGH TEMPERATURE CONVERSION—HEAT TO ELECTRICITY, TUCSON, ARIZONA, FEBRUARY 19-21, 1964. Earl W. Phelan, ed. (Arizona. Univ., Tucson and Argonne National Lab., Ill.). Contract W-31-109-eng-38. 428p. (CONF-458)

Separate abstracts were prepared for eighteen of the twenty papers included; two papers were previously abstracted in NSA (18: 18617, 18618). (D.C.W.)

For abstracts of individual papers see: 30175, 30176, 30177, 30484, 30485, 30486, 30487, 30488, 30489, 30490, 30491, 30492, 30493, 30494, 30495, 30496, 30497, and 30498.

30484 (TID-7687(p.10-20)) PROBLEMS AND PROGRESS IN THERMIONICS. J. M. Prosser (Division of Reactor Development, AEC).

The problems associated with thermionic conversion are discussed in relation to nuclear systems for space power. Progress in the field is also summarized. (D.C.W.)

30485 (TID-7687(p.21-6)) SOME SURFACE PHYSICS CONCEPTS IN THERMIONICS. Jules D. Levine (Radio Corp. of America. RCA Labs., Princeton, N. J.).

Some principles in the production of desired and practical work functions are reviewed. The merits of single crystal and polycrystalline surfaces and of pure and impure vapors are discussed. The use of semiconductors and alloys and compounds to provide low and high work functions is briefly considered. (D.C.W.)

30486 (TID-7687(p.27-44)) THE DEVELOPMENT OF NUCLEAR THERMIONIC MATERIALS. James F. Schumar (Argonne National Lab., Ill.).

Some research on thermionic emitters incorporating nuclear fuels is reported. The results of vaporization and vacuum emission studies on bare UC–ZrC and on the compatibility of uranium compounds with niobium and refractory metals (cladding) are summarized, together with emission-diffusion studies on the latter systems. (D.C.W.)

30487 (TID-7687(p.45-50)) NOBLE GAS PLASMAS AND EMITTER MATERIALS FOR NUCLEAR THERMIONIC CONVERTERS. Frank E. Jamerson (General Motors Corp. Research Labs., Warren, Mich.).

Ionization by fission fragments was investigated by measuring the characteristics of an ionization tube containing uranium foil and operating in neutron fluxes up to 1.2×10^{13} sec^{-1} cm^{-2} as a function of gas (Ne, Ar, Xe, and Ne: Ar) pressure. The results indicate that an ion source of 10^{16} ions sec^{-1} cm^{-3} can be generated with a gas pressure of 240 Torr. Two emitter materials, a high-temperature UC–Re cermet and a low-temperature $BaO-UO_2-W$ cermet, were developed. The low-temperature cermet provides current densities in vacuum of 7.2 amps/cm^2 at 1200°C. (D.C.W.)

30488 (TID-7687(p.58-73)) LOW-WORK-FUNCTION COLLECTORS FOR THERMIONIC ENERGY CONVERTERS. R. A. Chapman (Texas Instruments, Inc., Dallas).

The relation of the collector work function to power output and efficiency is discussed in terms of experimental and theoretical observations. The minimum work functions obtainable with present materials are also considered, together with compatible converter design for these materials. (D.C.W.)

30489 (TID-7687(p.74-91)) DOUBLE-DIODE THERMIONIC ENERGY CONVERTER. J. D. Long, J. Psaroutha-kis, and E. Scicchitano (Martin-Marietta Corp. Aerospace Div., Baltimore).

A double-diode thermionic module for out-of-pile testing was developed; and three double-diode converters, each consisting of two cylindrical diodes connected in series within a single sheath and using a common Cs reservoir, were fabricated and subjected to life and performance testing. Two double diodes with emitters of UO_2–Mo cermet clad with Mo–Ti were tested for 330 and 715 hr at emitter temperatures of 1500 to 2000°C. A third, unfueled diode with a solid Mo–Ti emitter has accumulated over 2000 hr of life tests at emitter temperatures of 1500 to 2100°C. Power output densities of 1.5 to 6 watts/cm^2 were obtained. (D.C.W.)

30490 (TID-7687(p.92-116)) THE DEVELOPMENT OF FISSION-HEATED THERMIONIC CONVERTERS. William A. Ranken (Los Alamos Scientific Lab., N. Mex.).

The merits and difficulties of in-pile testing of thermionic converters are discussed, and the techniques adopted at Los Alamos are illustrated by reviewing measurements on two assemblies, one with a UC–ZrC emitter and one consisting of three W emitter converters stacked in series. At a reactor power of 6 Mw, the former had a maximum power of 106 w and an efficiency of 11.9%. The corresponding values for the latter assembly are 36 w and 4.5%. (D.C.W.)

30491 (TID-7687(p.214-19)) CORRELATION OF INTERNAL VOLTAGE LOSS IN OPTIMIZED THERMIONIC CONVERTERS. Sotiris Kitrilakis (Thermo Electron Engineering Corp., Cambridge, Mass.).

The current density and voltage at the "knee" of an idealized current-voltage curve were calculated. The current density was in good agreement with experiment, but the voltages were notably larger than those observed. The difference (internal voltage drop) was found to be a unique function of the product of cesium pressure and spacing. The voltage drop reached a minimum value of 0.475 v at product values of 10–15 (mils × mm Hg). For values <10, the correlation breaks down. (D.C.W.)

30492 (TID-7687(p.220-46)) EXPERIMENTAL INVESTIGATION OF A CAVITY EMITTER. J. D. Dunlop (General Motors Corp. Allison Div., Indianapolis).

A converter with a slotted emitter was constructed and investigated. The measured electron current from the emitter was generally in agreement with the random current model. The sensitivity to spacing decreased with increasing emitter temperature. The plasma properties of a converter with a capillary emitter were investigated spectroscopically. The electron temperature and density were determined from the line intensities and broadening. (D.C.W.)

30493 (TID-7687(p.247-93)) BARIUM VAPOR-FILLED THERMIONIC ENERGY CONVERTERS. A. J. Kennedy and P. K. Shefsiek (Martin Co., Baltimore).

Experimental data are given for thermionic converters using barium vapors. Barium adsorption on refractory metal emitters, at temperatures from 1800 to 2000°K, is such that current densities of 1 to 10 amp/cm^2 are obtained at vapor pressures of less than 0.1 mm Hg. Consequently, power losses due to collisions in the interelectrode gap are quite small; and performance shows little dependence on interelectrode spacings, even for spacings as large as 0.020 to 0.050 in. Good output power densities were obtained with collector temperatures in excess of 1200°K. Anomalous effects were observed near the "knee" of the characteristics at intermediate electrode spacings. (auth)

30494 (TID-7687(p.294-320)) SOLAR ENERGY THERMIONIC (SET) CONVERTER DESIGN HISTORY.

Pierre J. Brosens (Thermo Electron Engineering Corp., Cambridge, Mass.).

The design, performance, life, and reliability requirements on thermionic converters for space power are given; and the development of thermionic converters for the JPL Solar Energy Thermionic Program from May, 1962, to November, 1963, is summarized. (D.C.W.)

30495 (TID-7687(p.321-43)) SPECTROSCOPIC OBSERVATIONS OF AN ARC-MODE CESIUM THERMIONIC CONVERTER. J. E. Rizzo and D. W. Bell (United Aircraft Corp., East Hartford, Conn.).

The arc-mode operation of a Cs-filled thermionic converter was observed using an f/4 grating spectrograph with photographic plates as the recording medium. A band spectrum of molecular Cs was observed in emission with an intensity structure significantly different from that reported from absorption studies. The emission bands adjacent to the primary atomic resonance line of Cs are the dominant band structure and appear to be excited directly by the trapped photons of the atomic resonance transition. The intensity and distribution of the molecular radiation indicate the presence of a significant number of excited Cs molecules. Six atomic lines were also observed which appear to be associated with forbidden transitions. The intensity behavior of the normal and forbidden atomic lines and molecular bands was found to differ under various operating conditions and positions within the interelectrode spacing. (auth)

30496 (TID-7687(p.344-59)) THERMIONIC BACK-PACK POWER SUPPLIES. W. R. Martini (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.).

Progress in the development of flame-fired thermionic converters is summarized. Comparisons of test results on collector and hot shell materials and on burners are presented. In the last year, notable progress in the development of a suitable hot shell material and heaters for converters with reasonable life and power density was made by adapting electrically heated converters to flame heating. (D.C.W.)

30497 (TID-7687(p.360-83)) FUELED DOUBLE-MODULE CONVERTERS: FABRICATION, TESTING AND EVALUATION. James E. Monroe, Jr., and D. W. Stoffel (Martin-Marietta Corp. Aerospace Div., Baltimore).

The fabrication, testing, and post-test evaluation of the fueled, double-diode thermionic modules previously discussed are described. (D.C.W.)

30498 (TID-7687(p.384-409)) IN-REACTOR TESTING OF NUCLEAR THERMIONIC CONVERTERS. Herman Miller (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.).

The design, fabrication, and testing of thermionic converters at Vallecitos are briefly reviewed. The test techniques (in- and out-of-pile) are described, and the problems are noted. Outputs of over 30 w/cm^2 and efficiencies of 20% have been obtained in out-of-pile tests. Five recent in-pile tests operated for over 200 hr, producing significant power at emitter temperatures of 1500 to 1800°C. (D.C.W.)

30499 THE DIRECT CONVERSION OF HEAT INTO ELECTRIC ENERGY BY MEANS OF THERMIONIC CONVERTERS. Ferdinand Arp (Universität, Kiel). Atomkernenergie, 9: 219-25(May-June 1964). (In German)

The direct conversion of heat to electric energy by thermionic converters is discussed. The physics of thermionic emission of electrons from a solid and the principals of operation of thermionic converters are outlined. Necessary conditions are discussed for reaching the saturation current at the chosen temperature of cathode and for optimizing the efficiency of energy conversion. Several methods are described for eliminating space charge occurring from electrons between the electrodes of converter. Neutralization of space charge with positive ions appeared to be the best mode of operation. Experimental converters and probable applications are briefly discussed. (auth)

30500 MODES OF AN AUXILIARY DISCHARGE THERMIONIC GENERATOR. C. A. G. Enstone (Associated Electrical Industries Ltd., Rugby, Warwicks, Eng.). Brit. J. Appl. Phys., 15: 653-63(June 1964).

A simple theoretical model of a generator in which the space charge is neutralized by an auxiliary discharge filling the main interelectrode space is considered. An analysis of the conditions which must be satisfied by each electrode sheath shows that the generator must operate in one of several modes depending upon the magnitude of the auxiliary discharge current. A method of calculating the complete characteristics for each mode as a function of the auxiliary and main discharge current is given. For the limiting cases of low and high auxiliary currents, calculations are made which agree satisfactorily, in view of the assumptions made, with experiment. It is concluded that devices in which the auxiliary discharge is physically separate from the main interelectrode space are likely to be more efficient. (auth)

30501 CONTINUOUS PUMPING OF CESIUM VAPOR DEVICES. J. R. Fendley, Jr. (RCA Labs., Princeton, N. J.). Rev. Sci. Instr., 35: 905-6(July 1964).

A cesium still and cold trap arrangement for use with thermionic energy converters or other cesium vapor devices are described. Use of the still eliminates the need for sealing off the cesium vapor device prior to normal operation. Impurity gases evolved during operation and impurities initially present in the cesium supply are removed by distillation. Continuous pumping relaxes the requirement for rigorous outgassing prior to cesium introduction. (C.E.S.)

30502 THE INFLUENCE OF CATHODE GEOMETRY ON THE WORK OF THERMIONIC CONVERTER. E. Badareu and C. Popovici (Inst. of Physics, Bucharest). J. Electron. Control (1), 16: 537-43(May 1964).

The double cathode effect in Cs thermionic energy converters was studied experimentally. For sufficiently small interemitter spacings, a current amplification is found. (auth)

30503 IN-CORE THERMIONIC CONVERTER TESTING AT LOS ALAMOS. William A. Ranken (Los Alamos Scientific Lab., N. Mex.). Nucl. News, 7: No. 7, 3-6 (July 1964). (LADC-6395)

The development of nuclear thermionic converters at Los Alamos is briefly reviewed, with emphasis on the required in-pile testing of converters and materials for various converter components. (D.C.W.)

30504 THERMOELECTRICITY AND DIRECT CONVERSION SYSTEMS. J. A. Krumhansl (Cornell Univ., Ithaca, N. Y.). p.912-35 of "Radiation Damage in Solids." New York, Academic Press, 1962.

The principles of equilibrium and irreversible thermodynamics common to all types of energy convertors are briefly reviewed, and applications of these principles to certain conversion systems are outlined. The equations defining the coupling between heat and work sources and sinks are established for solid-state systems, and some

materials considerations of semiconductor and thermionic systems are summarized. (D.C.W.)

Elementary Particles and Radiations

Refer also to abstracts 30033 and 30635.

30505 (AFOSR-4514) THE FOUNDATIONS OF SCATTERING THEORY AND APPLICATIONS TO PHYSICAL PROBLEMS. Final Research Report. (Maryland. Univ., College Park). Dec. 1962. Contract AF49(638)-24. 21p. (AD-414400)

Abstracts are given for programs in progress from May 1961 to the end of the contract period. These have been or will be published in journals regularly scanned for NSA. A list of 76 publications is given for the report period in addition to the abstracts. (R.E.U.)

30506 (BNL-7612) DEUTERON PRODUCTION IN P-P COLLISIONS IN THE RANGE 1.5 TO 2.5 Gev. F. Turkot, G. B. Collins, T. Fujii, M. A. R. Kemp, J. Menes, J. Oostens (Brookhaven National Lab., Upton, N. Y.); R. A. Carrigan, R. M. Edelstein, and N. C. Hien (Carnegie Inst. of Tech., Pittsburgh). Sept. 1963. Contracts AT-30-2-GEN-16 and AT(11-1)-423. 14p. (CONF-216-5)

From International Conference on Elementary Particles, Sienna, Italy, Sept.-Oct. 1963.

Deuteron energy spectra produced at 0^0 from a liquid hydrogen target by the external proton beam of the Brookhaven Cosmotron are reported. Complete spectra are given for energies (laboratory) of 1.55, 1.93, 2.11, and 2.50 Bev. Single-meson(π) production and a search for I = 1 meson(π) resonances were secondary aims. (R.E.U.)

30507 (CAR-882-4) SYMMETRIES AMONG THE STRONGLY-INTERACTING PARTICLES. R. E. Cutkosky (Carnegie Inst. of Tech., Pittsburgh). Apr. 1964. Contract AT(30-1)-882. 78p.

Strongly interacting particles exhibit regularities such as multiplet structure associated with isotopic spin and apparent clustering of multiplets into supermultiplets. A study was made of how these regularities reflect the interactions among the particles. Particle symmetries are described phenomenologically. The necessary introduction of compact Lie groups into the study of the regularities is investigated. SU(3) algebra is reviewed and irreducible representations are discussed. Empirical data are analyzed for SU(3)-predicted spins and parities of some supermultiplets. Electromagnetic interactions, baryon-meson coupling constants, vector octuplets, the baryon decuplet, a second baryon octuplet, cross section relations, mass formulas, crossing symmetry, and decuplet perturbations are discussed. Increased confidence in the validity of the "eightfold way" is reported. 99 references. (R.E.U.)

30508 (CERN-64-26) CERN WORK ON WEAK INTERACTIONS. A. Zichichi (European Organization for Nuclear Research, Geneva). June 3, 1964. 25p.

The validity of the universality of the Fermi interaction and of the conserved vector current hypothesis, the validity of the $(1 + \gamma_5)$ version of the universal Fermi interaction, the weak structure of the π-meson, the existence of induced pseudoscalar coupling (g_p), and neutrino physics are discussed. Experiments accompanying the studies are described. Invited paper presented at the Royal Society, London, Feb., 1964. (R.E.U.)

30509 (JINR-E-1659) ON AN INVESTIGATION OF THE ANALYTIC PROPERTIES OF SCATTERING AMPLITUDES IN THE NONRELATIVISTIC THREE-BODY PROBLEM. [PART] II. G. A. Chilashvili, R. M. Muradyan, V. P. Shelest, and A. N. Tavkhelidze (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 10p.

The Faddeev equations for the scattering amplitude in the nonrelativistic three-body problem are expanded in the partial waves. The integral equations with kernels expressed in terms of the scattering amplitudes of the two-body problem are obtained. (auth)

30510 (JINR-P-1622) RESONANSNIE VZAIMODEISTVIYA ELEMENTARNYKH CHASTITS. BOZONNIYE REZONANSY. (Resonance Interactions of Elementary Particles. Boson Resonances). V. G. Grishin (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1964. 84p.

A systematic review of theoretical and experimental data on boson resonances is given. 295 references (254 English references). (auth)

30511 (JINR-P-1654) OB ODNOM KOSVENNOM METODE POISKOV REZONANSOV. (On a Possible Indirect Method of Search for Resonances). G. I. Kopylov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1964. 12p.

A number of quantities are indicated that depend only on the direction of the resonance decay products and allow a determination of the resonance mass. The method is applicable to the decays of the type $\omega^0 \to \pi^0\gamma \to 3\gamma$, $f^0 \to 2\pi^0 \to 4\gamma$, $\eta \to 3\pi^0 \to 6\gamma$, $K^0 \to 3\pi^0 \to 6\gamma$, etc. (auth)

30512 (JINR-P-1662) ISSLEDOVANIE ANALITICHESKIKH SVOISTV AMPLITUDY RASSEYANIYA V NERELYATIVISTSKOI ZADACHE TREKH TEL. I. (An Investigation of the Analytic Properties of the Scattering Amplitude in the Non-Relativistic Three-body Problem. [Part] I.). I. Sh. Vashakidze, R. M. Muradyan, A. N. Tavkhelidze, G. A. Chilashvili, and V. P. Shelest (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 16p.

The equations for the partial amplitudes in the three-body problem are obtained. The perturbation theory is developed for the Faddeev equations. A possibility of reducing the cuts in the complex plane of the total angular momentum is discussed. (auth)

30513 (NP-14047) ASYMPTOTIC BEHAVIOUR OF ESSENTIALLY INELASTIC COLLISIONS. K. A. Ter-Martirosyan (U.S.S.R. Sovet Ministrov. Glavnoe Upravlenie po Ispol'zovaniyu Atomnoĭ Energii. Institut Teoreticheskoĭ i Eksperimental'noĭ Fiziki, Moscow). 1964. 34p.

The asymptotic value of the amplitude for the reaction $a + b \to c + d + e$ was obtained previously in the case when the energy E_{cd} of a pair of particles c and d remains small as $E_{ab} \to \infty$. Consideration is given to the case when all the three energies E_{cd}, E_{de}, and E_{ce} are high and the transverse components of the momenta of the particles c, d, and e are small as $E_{ab} \to \infty$. The asymptotic value of an amplitude in its correct form is shown to depend on the same number of variables as the amplitude itself and is sensitive to any change of the particle momenta. Brief consideration is given to the asymptotic values in the case when the extreme right singularity in the j-plane is not an isolated pole, but like a branching point, a point of condensation of poles, or accumulation of branching points. (R.E.U.)

30514 (NP-14048) ASYMPTOTIC BEHAVIOUR OF PARTICLE PRODUCTION AMPLITUDES IN QUASI-ELASTIC SHOWER PROCESSES. A. M. Popova and K. A. Ter-Martirosyan (U.S.S.R. Sovet Ministrov. Glavnoe

Upravlenie po Ispol'zovaniyu Atomnoĭ Energii. Institut Teoreticheskoĭ i Eksperimental'noĭ Fiziki, Moscow). 1964. 41p.

The method of complex angular momenta is used to obtain the asymptotic values of the amplitudes of inelastic processes and, in particular, of reactions of the type a + b → c + d + e. The case of quasielastic collisions when two of three particles are produced with low energies in their c.m.s. is considered. Techniques of expansion in helical amplitudes corresponding to certain values of the total momentum j of the entire system and orbital momentum l' of any pair of produced particles are used. Analytical continuation of partial amplitudes (with two types of signature) into the plane of complex values of the angular momenta j are obtained and their analytical properties in this plane are investigated. It is shown in particular that partial amplitudes vanish at all integral unphysical values j = n smaller than the momentum projection (helicity). Certain drawbacks of a paper published earlier are eliminated in the derivation. Brief consideration is given to the kinematics of quasielastic and essentially inelastic collisions of the type a + b → c + d + e, the asymptotic values of quasielastic collision amplitudes being obtained in a form convenient for the transition to the limiting case of essentially inelastic collisions. (auth)

30515 (NP-14096(p.1-4)) MESON EMISSION ASYMMETRY, INELASTICITY, AND MULTIPLICITY IN ULTRA-HIGH ENERGY INTERACTIONS. B. Hildebrand and R. Silberberg (Naval Research Lab., Washington, D. C.).

International Cooperative Emulsion Flight data are used to show that for interactions by ~5 Tev nucleons, the inelasticity in the incident particle system has a wide and flat distribution. This is contrasted with the Gaussian inelasticity distribution of meson-initiated interactions. Both distributions are interpreted in terms of asymmetric emission of produced particles in the c.m. system of the colliding particles. (R.E.U.)

30516 (NYO-1807-12) PHENOMENOLOGICAL p-p AND n-p PHASE PARAMETERS. G. Breit, A. N. Christakis, M. H. Hull, Jr., H. M. Ruppel, and R. E. Seamon (Yale Univ., New Haven). June 18, 1964. Contract AT (30-1)-1807. 8p. (CONF-550-1)

From The International Conference on High-Energy Physics, Dubna, Aug. 1964.

Phase-parameter searches on p-p and n-p scattering data at 0 to 350 Mev are reported. (R.E.U.)

30517 (PAN-492/VI) EMISSION OF NEUTRONS IN π^--p INTERACTIONS AT 10 Gev. M. Bardadin, J. Bartke, A. Eskreys, and W. Zieliński (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Jan. 1964. 16p.

An attempt was made to investigate the production of neutrons in π^- interactions in the hydrogen bubble chamber at 10 Bev/c. On the basis of 54 events, which fulfilled all selection criteria, it was found that neutrons are emitted in 42 ± 13% of interactions. The angular distribution of neutrons in the center-of-mass system is peaked backwards. (auth)

30518 (PAN-495/VII) RELATIVISTIC INVARIANCE IN MULTIPARTICLE REACTIONS. J. Werle (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Feb. 1964. 21p.

The problem of constructing quantum representations for relativistic multiparticle systems is studied from the point of view of the Poincaré group. It is shown that it is equivalent to the problem of reducing N-fold direct products of irreducible vector spaces to direct sums over different, mutually orthogonal, and irreducible subspaces. The method of Poincaré invariants and several advantages of evidently invariant quantum numbers are discussed. (auth)

30519 (TID-20712) IMPLICATIONS OF APPROXIMATE SU_3 SYMMETRY AND MASS FORMULAE FOR THE MESONS. F. Gursey (Institute for Advanced Study, Princeton, N. J.); T. D. Lee, and M. Nauenberg (Columbia Univ., New York). [1963]. Contract AT(30-1)-937. 48p.

The connection between the limit of perfect SU_3 symmetry and the zero-mass approximation for the pseudoscalar meson octet is discussed. The well-known quadratic mass formula for the pseudoscalar meson octet and the linear mass formula for the baryons are derived. A simple model of strong interaction is presented which leads to two mass formulas for the nine spin-1 mesons: $2M_\phi + M_\rho + M_\omega = 4M_{K^*}$, and $M_\rho \cong M_\omega$. The general invariance property of this model, which contains, among others, a baryon octet, a pseudoscalar octet, and a vector nonet, is examined. (auth)

30520 (TID-20720) LOW-ENERGY NUCLEAR PHYSICS. Final Report, June 1, 1959–May 31, 1964. William W. Pratt (Pennsylvania State Univ., University Park. Coll. of Sciences). June 1964. Contract AT(30-1)-2399. 202p.

The report consists of five papers and numerous abstracts of published articles. Four of the papers are abstracted separately; the other was previously abstracted in NSA (as abstract number 18: 18701). (T.F.H.)

For abstracts of individual papers see: 30521, 30522, 30523, and 30619.

30521 (TID-20720(Paper 3)) ANALYSIS OF THE 213-Mev PROTON-PROTON SCATTERING DATA. Peter Signell, N. R. Yoder, and J. E. Matos (Pennsylvania State Univ., University Park). 52p.

Modified phase shift analyses have been made of the 213-Mev data, with a statistical argument used to eliminate three of the data. The methods of obtaining the least squares fit to the data, and of choosing the phase shifts to be searched upon, are examined. Thirteen free phases are preferred, and most of these are found to have very small uncertainties. Several of the data subgroups give unexpectedly low contributions to χ^2, but are still influential in limiting the phase shift standard deviations. All models proposed for the proton-proton interaction give an order of magnitude poorer fit to the data than does the modified phase analysis. The solution of the type 2 of SYM (Stapp-Ypsilantis-Metropolis) has a χ^2 probability less than 1%. The pion-nucleon coupling constant could only be roughly evaluated, giving qualitative evidence for the one pion exchange mechanism. Estimates have been made of the effectiveness of several possible extensions of the measurements. (auth)

30522 (TID-20720(Paper 4)) POLE AND CONTINUUM CONTRIBUTIONS TO PROTON-PROTON SCATTERING. John W. Durso and Peter Signell (Pennsylvania State Univ., University Park). 24p.

The $N\bar{N} \to 2\pi$ s- and p-wave and ω contributions to proton-proton scattering have been computed. Anomalies in the phase shifts have disappeared. In addition, the 2π s-wave contribution is shown to be indistinguishable in effect from the exchange of a scalar meson with a mass of about 400 Mev. However, the 2π d- and higher-wave contributions cannot be accurately represented by the exchange of scalar mesons. Either: the calculated higher-wave contributions contain numerical errors; or a different mechanism is needed for the 2π s- and p-wave contributions; or the theoretical approximations used are not sufficient. (auth)

30523 (TID-20720(Paper 5)) EFFECT OF THE HARWELL A(Θ) DATA ON THE 50 Mev PROTON-PROTON PHASE SHIFTS. Peter Signell (Pennsylvania State Univ., University Park). 13p.

The A(Θ) and σ(90°) data at 50 Mev are found to decrease the probable range of the phase shifts. The $^3F_3$ phase, however, is strongly predicted by the data to be far from the value expected on the basis of models; this reflects on the consistency of the data. The most significant result is the rejection of solution 2 of Stapp, Ypsilantis, and Metropolis. (auth)

30524 (TID-20750) π^--p INTERACTIONS AT 683 Mev/c. Technical Report No. 346. R. A. Burnstein, G. Charlton, T. B. Day, G. Quareni, A. Quareni-Vignudelli, and G. B. Yodh (Maryland. Univ., College Park). Jan. 1964. Contract AT(40-1)-2504. 36p.

Interactions of 683-Mev/c mesons (π^-) with protons were investigated using a 14-in. hydrogen bubble chamber in a 17-kilogauss field. Two thousand elastic scatterings were analyzed yielding a cross section of 18.91 ± 1.01 mb. No evidence for powers of cos θ higher than two was observed in the elastic angular distribution. The angular distribution obtained was $(d\sigma/dw) = (0.384 \pm 0.026) + (1.70 \pm 0.06)\cos\theta + (3.36 \pm 0.11)\cos^2\theta$(mb/sterad). The single meson (π) production reactions $\pi^- + p \rightarrow \pi^- + \pi^0 + p$ and $\pi^- + p \rightarrow \pi^- + \pi^+ + n$ were studied in detail. A total of 441 π^0 productions and 833 π^+ productions were analyzed giving a cross section of 3.99 ± 0.21 and 7.50 ± 0.40 mb, respectively. The differential distributions for these inelastic processes are presented and compared with the predictions of the model of Olsson and Yodh. The distribution of events on the Dalitz plots for π^0 production is accounted for by the model. However, for the π^+ reaction, the model (so far developed) does not describe adequately the distribution of events on the Dalitz plot. The center-of-mass angular distributions for π^0 and π^+ production reactions are presented and compared with the model. (auth)

30525 (TID-20769) A NEW DETERMINATION OF THE MASSES OF Σ^- AND Σ^0 HYPERONS. Technical Report No. 382. R. A. Burnstein, T. B. Day, B. Kehoe, B. Sechi-Zorn, and G. A. Snow (Maryland. Univ., College Park). June 1964. Contract AT(40-1)-2504. 15p.

The mass of the Σ^- hyperon was determined in terms of the better known masses of the other particles in the reactions $K^- + p \rightarrow \Sigma^- + \pi^+$, $\Sigma^- + p \rightarrow \Lambda + n$, and $\Sigma^- + p \rightarrow \Sigma^0 + n \rightarrow \Lambda + e^+ + e^- + n$ observed in the 81-cm Saclay hydrogen bubble chamber. The momenta of Σ^- and Λ were measured, and the (Σ^-,Σ^0) mass difference was determined. (R.E.U.)

30526 (TID-20771) $K_1^0 - K_2^0$ MASS DIFFERENCE AND THE S-WAVE T = 0 PION PION INTERACTION. Tran N. Truong (Columbia Univ., New York). [1964]. Contract [AT(30-1)-1808]. 30p.

The contribution due to the two-meson(π) intermediate state to the mass difference Δm of $K_1^0 - K_2^0$ is calculated. In a simple model for meson(π) – meson(π) scattering where crossing is neglected, a simple relation is obtained between the lifetime τ_1 of K_1^0, the mass difference Δm, and the S-wave meson(π) – meson(π) phase shift in the isospin state T = 0: $2\tau_1\Delta m = -\cot\delta$. The effect of crossing is estimated by including only the contribution of ρ to the S-wave dispersion relation for π-π scattering. For this purpose, the crossing relations derived by Shirkov are used. It is found that even including the ρ exchange in the cross channel, the qualitative feature of the formula $2\tau\,\Delta m = -\cot\delta$ remains valid. (auth)

30527 (TID-20773) A FINAL-STATE INTERACTION MODEL IN THE REACTION $\pi + N \rightarrow \pi_1 + \pi_2 + N'$ BELOW 1 Bev (thesis). Technical Report No. 379. Martin Olsson (Maryland. Univ., College Park). May 1964. Contract AT(40-1)-2504. 159p.

A phenomenological model for the single-pion-production process in pion-nucleon reactions is presented. It is the purpose of this model to identify those aspects of the experimental data that are determined by the effects of known final-state interactions, and hence, to calculate some of the gross properties of the "primary mechanism" and its relation to the elastic pion-nucleon channel. It is concluded that: (1) In T = ½ production reactions both $P_{\frac{3}{2}}^+$ and $D_{\frac{3}{2}}^-$ states are large and attractive below 700 Mev. The latter has a phase angle that is rapidly increasing, passing through 90° near 500 Mev. From the relation of this phase angle to the elastic scattering phase shift, a connection to the well known 600 Mev "resonance" is established. (2) Below 700 Mev the T = ³/₂ production occurs strongly through an attractive $D_{\frac{3}{2}}^-$ state and a repulsive $P_{\frac{3}{2}}^+$ state. (3) Energy and angle distributions as well as the energy dependence of the cross sections are accounted for in the five experimentally known production reactions. The prominent exception to the preceding statement is the appearance of an anomaly in the pion-pion mass spectra in the two reactions in which the two pions might be in a T = 0 state. The model assumes that only those amplitudes are important in which there exists an attractive interaction between two of the three particles in the final state. At medium incident energies (below 1 Bev) the only known interactions of this type are: (1) the well known $(3,3)^+$ pion-nucleon resonance, and (2) the α_1 pion-nucleon scattering length interaction. The lowest angular momentum configurations in which these final state scatterings can participate correspond to $D_{\frac{3}{2}}^-$ and $P_{\frac{3}{2}}^+$ in the initial beam. A model was constructed, which is close enough to reality to be able to fit the experimental data, but yet make a minimum of assumptions about the nature of underlying dynamics. In order to do this improvements were made on the usual "isobar model" by taking into account the correct angular momentum properties of the isobar and retaining the interference terms that arise because differently charged pion-isobar intermediate states can result in the same final three-particle state. (auth)

30528 (TID-20814) MEASUREMENT OF PHOTO-SIGMA PRODUCTION NEAR THRESHOLD AND DETERMINATION OF THE SIGMA MAGNETIC MOMENT (thesis). Alfred Don McInturff (Vanderbilt Univ., Nashville. Graduate School). May 1964. 136p.

The photoproduction cross section for Σ^+ hyperons near threshold for the reaction $\gamma + p \rightarrow \Sigma^+ + K^0$ was studied. Experimental and theoretical aspects are discussed. A Fortran program for calculating the magnetic moment of the Σ^+ hyperon is given. (R.E.U.)

30529 (UCRL-7871-T) AN S-MATRIX THEORY OF THE VERTEX $\rho \rightarrow N\bar{N}$ BASED ON THE STRIP APPROXIMATION. M. Der Sarkissian (California. Univ., Livermore. Lawrence Radiation Lab.). May 1964. Contract W-7405-eng-48. 26p.

The $\pi\pi \rightarrow N\bar{N}$ amplitudes are studied in the neighborhood of the ρ-meson mass, and a simple dynamical calculation based on a consistent use of the strip approximation is proposed to study the vertex $\rho \rightarrow N\bar{N}$. In particular, the vertex $\rho \rightarrow N\bar{N}$ is expressed in terms of a "potential" (assumed to get its strongest contributions from low-mass baryon states exchanged in the πN channels) and the J = 1, I = 1 ππ phase shifts. It is possible to generate the vertex $\rho \rightarrow N\bar{N}$ and compare this prediction with experimental information about the nucleon electromagnetic structure. If

there is agreement, this will provide a posteriori justification of the strip approximation in bootstrap calculations in the πN and NN systems. In both cases the vertex $\rho \rightarrow N\bar{N}$ plays a nontrivial role. The ρ-meson can couple to the $N\bar{N}$ system in two ways; first, ρ can couple to the charge of the nucleon (call this coupling γ_N) and second, to the magnetic moment (call this coupling γ'_N). If the coupling of $\rho \rightarrow \pi\pi$ is denoted as γ_π, the results of this analysis can be summarized as follows: $[(\gamma'_N/\gamma_\pi) = -(6/\gamma_\pi^2)(2.3)]$; $[(\gamma_N/\gamma_\pi) = -(6/\gamma_\pi^2)(0.85)]$; and $(\gamma'_N/\gamma_N) = +2.7$. The first two numbers depend on the details of the strip approximation used for ππ scattering. The ratio γ'_N/γ_N is relatively independent of these details. It is also possible to calculate γ'_N/γ_π, γ_N/γ_π, and γ'_N/γ_N from the nucleon electromagnetic structure. The results are: $[(\gamma'_N/\gamma_\pi) = -(6/\gamma_\pi^2)(2.6)]$; $[(\gamma_N/\gamma_\pi) = -(6/\gamma_\pi^2)(0.7)]$; and $(\gamma'_N/\gamma_N) = +3.7$. Again the first two numbers depend on the details of the strip approximation used for ππ scattering and the third is relatively independent of these details. (auth)

30530 (UCRL-10926) LEPTONIC DECAYS OF HYPERONS. RESULTS OF A SEARCH IN 1.05- TO 1.75-Bev/c K^- INTERACTIONS IN HYDROGEN. PART I. MUONIC Λ DECAYS. Margaret H. Alston, Janos Kirz, Jim Neufeld, Frank T. Solmitz, and Peter G. Wohlmut (California. Univ., Berkeley. Lawrence Radiation Lab.). July 25, 1963. Contract W-7405-eng-48. 13p.

Examples of the decay mode $\Lambda \rightarrow p + \mu^- + \bar{\nu}$ were searched for in a sample of K^--p interactions in a 72-inch hydrogen bubble chamber. Among 30,000 events of the type "two-prong + V," one unambiguous and three possible examples of this decay mode were found. Other possible interpretations of these events are examined. It is concluded that the decay branching ratio is about 1.2×10^{-4}. (auth)

30531 (UCRL-11100) AN ELEMENTARY (?) GUIDE TO THE ELEMENTARY (?) PARTICLES. Arthur Rosenfeld (California Univ., Berkeley. Lawrence Radiation Lab.). May 1964. Contract W-7405-eng-48. 17p.

A discussion is presented of the four basic forces of nature, atomic and nuclear states, quantum numbers, particle resonances and their occurrences and recurrences, supermultiplets, and the eightfold way. (R.E.U.)

30532 (UCRL-11382) ELASTIC ALPHA-ALPHA SCATTERING NEAR 40 Mev. H. E. Conzett, R. J. Slobodrian, S. Yamabe, and E. Shield (California. Univ., Berkeley. Lawrence Radiation Lab.). Apr. 21, 1964. Contract W-7405-eng-48. 7p. (CONF-502-13)

From the International Congress of Nuclear Physics, Paris, July 1964.

In order to investigate suggested rapid energy variation of the s, d, and g-wave phase shifts near 40 Mev, differential cross sections were measured for alpha-alpha scattering over center-of-mass angles from 16 to 100 degrees at nine energies between 37 and 43 Mev. Analysis of these data is underway and is directed toward determining whether resonances corresponding to states in ^8Be or threshold effects of opening reaction channels are responsible for the indicated behavior of the phase shifts. (auth)

30533 ANGULAR CORRELATIONS FOR THE REACTION $\bar{p} + d \rightarrow p + \pi^- + \omega$. T. Zieliński (Univ. of Warsaw). Acta Phys. Polon., 25: 589-98(Apr. 1964).

The transition probability for the reaction $\bar{p} + d \rightarrow p + \pi^- + \omega$ is calculated for the case of slow antiprotons. Because of the simplifications introduced, it contains only four unknown matrix elements, T_1^{J}: $T_0^{1/2}$, $T_1^{1/2}$, $T_1^{3/2}$, $T_2^{3/2}$. The final result is compared with the shape of the transition probability for the more elementary process $p + n \rightarrow \pi^- + \omega$, assuming that the additional proton has only the role of a spectator. (auth)

30534 RELATIVISTIC BIPOINT AS THE MODEL OF ELEMENTARY PARTICLE. Zbigniew Borelowski and Bronislaw Średniawa (Jagellonian Univ., Krakow). Acta Phys. Polon., 25: 609-16(Apr. 1964).

A bipoint classical model of elementary particles consisting of two point singularities is proposed. This model is closely connected with the bilocal theory of Rayski and others. Relativistic equations of motion are derived by the method of Weyssenhoff. The solution of these equations is a circular motion of both singularities in an appropriately chosen frame of reference about their mass center. A dependence of spin on mass for baryons and their resonances is derived, which agrees fairly well with experimental data. (auth)

30535 SPEED AND KINETIC ENERGY OF RELATIVISTIC ELECTRONS. William Bertozzi (Massachusetts Inst. of Tech., Cambridge). Am. J. Phys., 32: 551-5(July 1964).

Using a Van de Graaff electrostatic generator and a linear accelerator, the speeds of electrons with kinetic energies in the range 0.5–15 Mev are determined by measuring the time required for the electrons to traverse a given distance. The measurements show the existence of a limiting speed in accord with the results of special relativity. The kinetic energy, determined by calorimetry, verifies that an electric field exerts a force on a moving electron in its direction of motion that is independent of its speed. (auth)

30536 PARTICLE ORBIT THEORY FOR AN IONIZED GAS. P. Mallozzi (Yale Univ., New Haven). Am. J. Phys., 32: 556-8(July 1964).

The electrical and optical properties of an ionized gas are derived from a simple physical consideration, based on the average energy acquired by an electron between collisions. The correct formulas are obtained if a time-dependent collision frequency is employed. (auth)

30537 RAPIDLY CONVERGING CALCULATION OF ϵ OR $1/\epsilon$ IN DISCUSSION OF RADIOACTIVE DECAY. A. B. Arons (Amherst Coll., Mass.). Am. J. Phys., 32: 570-1 (July 1964).

A finite difference procedure for a simple, rapidly converging calculation of the number ϵ is shown. (L.B.S.)

30538 FACTORS INFLUENCING THE DETERMINATION OF ERRORS IN THE MAGNETIC FIELD APPLIED TO THE SURFACE OF RELATIVISTIC PROTONS IN EQUAL PARTS OF THE CURVATURE OF THE EMULSION. J. Catala, E. Villar, P. Zielinsky, A. Lleo, G. Pardo, R. Llosa, and J. L. Gomez (Facultad de Ciencias, Valencia). Anales Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 60: 13-18(Jan.-Feb. 1964). (In Spanish)

With 107 tracks of 13.8 Bev/c protons in a pulsed magnetic field, the fluctuation of that field was evaluated to be about 10%. The experimental error in momentum was about 14.4%. The contribution of Coulomb scattering in the curvature arc amounted to 10%, while other errors, mainly due to distortion, were less than 2%. (auth)

30539 CHARGE EXCHANGE FROM PROTONS TO BOUND NEUTRONS AND FROM MESONS (π) TO BOUND PROTONS AT HIGH ENERGIES. F. Steinrisser, B. Hahn, and W. Lindt (Universität, Fribourg, Switzerland). Helv. Phys. Acta, 37: 113-35(1964). (In German)

With a 2 liter $CBrF_3$ bubble chamber the cross section for elastic p-n charge exchange at 25 Bev proton energy and upper limits for the cross sections for π^--p elastic charge exchange at 6, 10.5, and 16 Bev π^- energy were ob-

tained by scanning for disappearing tracks. The values were 50 ± 20 μb/neutron, < 100, < 55 ± 20, and < 10 μb/proton, respectively. Total cross sections for the processes $p + n \rightarrow n + p$ + neutrals and $\pi^- + p \rightarrow$ neutrals are also given. The angular distribution gave some indication of the exchange processes involved. Comparison between the angular distribution for charge exchange and for elastic scattering was made in order to study possible nuclear effects. At 10.5 Bev some evidence for the η^0 meson was found from the 2-γ decay mode. (auth)

30540 MASS MULTIPLICITY OF ELEMENTARY PARTICLES. R. Gerharz (Geological Survey, Washington, D. C.). Indian J. Pure Appl. Phys., 2: 199-200(June 1964).

The masses or "resonances" of all known particles are shown to involve only Sommerfeld's constant and whole numbers. These are characteristic multiplicity factors, which are based on the mass of the electron. (auth)

30541 CONSTRUCTION OF EXACT SPIN EIGENFUNCTIONS. V. H. Smith, Jr. (Uppsala Univ.). J. Chem. Phys., 41: 277-8(July 1, 1964).

The construction of an eigenfunction of S^2 and S_z with eigenvalues S(SH) and M, respectively, for an assembly of N spin-½ particles of which μ have z component up and $\nu = N - \mu \leq \mu$ have z component down, is described. Jacobi polynomials and a generalized hypergeometric series were used. (M.C.G.)

30542 ZERO-MASS REPRESENTATIONS OF THE PROPER INHOMOGENEOUS LORENTZ GROUP. David Korff (Univ. of Maryland, College Park). J. Math. Phys. (N. Y.), 5: 869-77(July 1964).

The representations of the proper inhomogeneous Lorentz group are investigated as functions of both real and imaginary mass, in the limit as the mass approaches zero. Only the physical mass-zero representations are obtained in either limit, the infinite spin representations being unique to zero mass. It is found that there exists a superselection rule which prohibits the position and spin operators from being physically observable in the mass-zero limit. (auth)

30543 UNIQUENESS OF 4- AND 8-DIMENSIONAL SPACES. D. C. Peaslee (Australian National Univ., Canberra). J. Math. Phys. (N. Y.), 5: 897-9(July 1964).

Among rotation groups R_n, the cases n = 4 and 8 are unique in having two inequivalent n × n representations. Mathematically this phenomenon is related to the uniqueness of quaternions and octonions; physically these groups seem to underlie the real and charge-space symmetries of elementary particles. An attempt is made to interpret this fact by assuming a lack of inherent geometrical preference between Fermi–Dirac and Bose–Einstein statistics. Corollaries are the identity of real and charge-space statistics and the complete disjointness of real and charge-space coordinates. (auth)

30544 SINGULAR BETHE-SALPETER SCATTERING AMPLITUDES. Arthur R. Swift and Benjamin W. Lee (Univ. of Pennsylvania, Philadelphia). J. Math. Phys. (N. Y.), 5: 908-21(July 1964).

The Bethe–Salpeter equation for scattering is investigated in configuration space for the class of singular potentials (i.e., a $\lambda\phi^4$ theory in the ladder approximation) which behave as r^{-4} near the light cone. The discussion relies on the similarity between solutions of the Bethe–Salpeter equation and the Schrödinger equation, where the corresponding problem is scattering by a r^{-2} potential. Through a consideration of the asymptotic properties of the two-particle free Green's function, the elastic scattering amplitude is shown to be the coefficient of the outgoing wave part of the wavefunction, just as it is in the nonrelativistic case. At zero total energy, it is simply the coefficient of $e^{-mr}/r^{\frac{1}{2}}$. The differential form of the Bethe–Salpeter equation is expanded in four-dimensional spherical harmonics, and the singular part of the potential is incorporated into the differential operator. The resulting equation is formally solved by converting it into a Fredholm integral equation. Care is taken to choose the proper asymptotic behavior for the solutions of the new equation. The discussion of the singular potential is carried out at zero total energy in order to obtain spherical symmetry. The technique for handling the singular potential and extracting the T matrix at zero energy is demonstrated by application to two examples. The exact scattering amplitude is found for exchange of two massless mesons. A first-order solution is obtained for a phenomenological potential that approximates the exchange of two massive mesons. This solution exhibits many of the features expected from a truly physical potential. (auth)

30545 ON THE CANONICAL RELATIVISTIC KINEMATICS OF N-PARTICLE SYSTEMS. A. Chakrabarti (Ecole Polytechnique, Paris). J. Math. Phys. (N. Y.), 5: 922-9(July 1964).

The canonical relativistic kinematics is discussed for n-particle systems. The formulas are derived in as simple and symmetrical a way as possible, and thus the extra complications arising for n > 2 in the usual stepwise generalization of the two-particle method are avoided. The canonical form of the infinitesimal operators (N, M) is obtained in a highly symmetrical form. It is then shown that, though the restrictions imposed by the condition that the states be also energy eigenstates compels a sacrifice of part of the symmetry and simplicity of the formulas, the effect of the spins of the component particle can be included in a completely symmetric way. Thus additional complications introduced when the component particles have nonzero spins are lessened. The corresponding, relatively simple, generalized (C–G) coefficients connecting the canonical and the direct-product states are calculated. It is shown that the use of spinor representation for the individual particles simplifies the deductions considerably. Explicit results are given usually for n = 3 only. (auth)

30546 DEUTERON POLARIZATION FOLLOWING NEUTRAL PION PHOTOPRODUCTION. G. Ramachandran and R. K. Umerjee (Inst. of Mathematical Sciences, Madras). Nucl. Phys., 54: 665-72(June 1964).

The spin state of the deuteron following elastic photoproduction of neutral pions is investigated in impulse approximation using the photoproduction amplitudes of Chew et al. (auth)

30547 REMARKS ABOUT POLARIZATION IN ELASTIC ELECTRON-DEUTERON SCATTERING. M. Gourdin and C. A. Piketty (Physique Theorique, Orsay, France). Nuovo Cimento (10), 32: 1137-43(June 1, 1964).

The electron-deuteron elastic scattering cross section is investigated to determine the deuteron electromagnetic form factor. Polarization effects in the deuteron electromagnetic vertex are taken into account. (C.E.S.)

30548 PION-ELECTRON SCATTERING AT 16 Gev/c. J. Allan (Univ. of Stockholm), G. Ekspong, P. Saellstroem, and K. Fischer. Nuovo Cimento (10), 32: 1144-50(June 1, 1964).

The pion-electron scattering cross section as a function of the four-momentum transfer was measured using 16

Bev/c negative pions incident on a hydrogen bubble chamber. The results are compared with theory. The overall agreement is good. A tendency, at high momentum transfers, toward lower experimental cross sections than are expected from the theory for point-charge scattering was interpreted in terms of an extended pion. No definite conclusion on the pion size can be drawn other than that the radius is smaller than 4.5×10^{-15} m. (auth)

30549 ON THE UNIVERSALITY OF THE WEAK INTERACTIONS MEDIATED BY VECTOR BOSONS. G. Dorman (Stanford Research Inst., Menlo Park, Calif.). Nuovo Cimento (10), 32: 1226-33(June 1, 1964).

A calculation was made of the radiative corrections, to order α, to muon and beta decay mediated by a vector boson. The essential result is that the present experimental lower limit of 1.5 Bev on the mass of this boson, as indicated by recent experiments, is much larger than the mass required to agree with the consequences of universality. (auth)

30550 BREMSSTRAHLUNG, RADIATIVE CORRECTIONS AND PION PRODUCTION IN MUON-PROTON SCATTERING. M. P. Locher (Universität, Bern). Nuovo Cimento (10), 32: 1258-68(June 1, 1964).

Radiative corrections to muon-proton scattering are calculated to order α^3. Hard bremsphotons emitted by the muon are included. The radiation of the proton, however, is neglected. The phase-space integrations performed are suited for an experiment in which the recoil proton alone is observed. The cross sections for π production in muon- (or electron-) proton scattering are estimated using the covariant Weizsäcker-Williams method. Numerical results based on experimental values for the pion photoproduction cross section and for the form factors of the proton, are given in diagram form. (auth)

30551 AN ANALYTICITY TEST IN THE THEORY OF COMPLEX ANGULAR MOMENTUM. E. Albino (Università, Genoa), M. Bertero, and G. A. Viano. Nuovo Cimento (10), 32: 1269-94(June 1, 1964).

From the solution of the interpolation problem in the theory of complex angular momentum, a system of equations can be derived that are satisfied by the values of an analytic function f(z) (regular in the half-plane Re $z > 0$) on a set of equally spaced points. The ability of this system to work as an analyticity test is investigated. A numerical analysis is made on some trial functions and on some available experimental data. (auth)

30552 SEPARATION OF THE ROTATIONAL DEGREES OF FREEDOM FROM THE N-PARTICLE SCHRÖDINGER EQUATION. A. Kihlberg (Chalmers Univ. of Tech., Goteborg). Nuovo Cimento (10), 32: 1295-1300(June 1, 1964).

By introducing the interparticle distances together with Eulerian angles and the barycentric coordinates into the N-particle hamiltonian a separation of the rotational motion to zeroth order in the vibrational amplitudes is obtained in the particular case when the particles possess relative equilibrium positions. An expression for the first order coupling term and the hamiltonian for the quantal rigid body are derived. (auth)

30553 ON THE POSSIBLE USE OF POLARIZED TARGETS FOR THE DETERMINATION OF RESONANCE SPINS AND PARITIES. M. K. Gaillard (CERN, Geneva). Nuovo Cimento (10), 32: 1306-20(June 1, 1964).

Under certain conditions the use of polarized targets permits the determination of resonance spins and parities. Effects which may be observed in several experimental situations are calculated as a function of these two quantum numbers. (auth)

30554 ON THE MOMENTUM DISTRIBUTION OF SECONDARIES IN HIGH-ENERGY COLLISIONS. A. Bassetto (Università, Padua and Scuola di Perfezionamento in Fisica dell'I.N.F.N., Padua). Nuovo Cimento (10), 32: 1321-36 (June 1, 1964).

In the framework of the multiperipheral model a new method is proposed in order to find out the most probable configuration in the momenta of secondaries on the basis of purely kinematical and correlative considerations. The problem is solved by an iterative procedure in all allowed phase space. The behavior around the maximum is discussed. (auth)

30555 VARIATIONAL CALCULATIONS ON K^--DEUTERIUM ELASTIC SCATTERING. Ramesh Chand (Syracuse Univ., N. Y.). Nuovo Cimento (10), 32: 1348-59 (June 1, 1964).

In the multiple-scattering theory of K^--deuterium interactions, the first-order correction to the zeroth-order (asymptotic) value of the K^--deuterium elastic scattering amplitude is calculated, using Kohn's variational method for nuclear collisions. A comparison between the variational and the transition probability methods for the calculation of K^--d elastic scattering amplitude shows that as a function of K^- momentum, the variational method gives slightly smaller values of the scattering amplitude. (auth)

30556 A UNITARY SYMMETRY SELECTION RULE AND ITS APPLICATION TO NEW RESONANCES. C. A. Levinson (Weizmann Inst. of Science, Rehovoth, Israel), H. J. Lipkin, and S. Meshkov. Nuovo Cimento (10), 32: 1376-9(June 1, 1964).

A selection rule is formulated which forbids the decay into two pseudoscalar mesons of all members of a unitary multiplet containing a neutral boson which is odd under CP. It is applied to the classification of resonances like the κ and B which decay into pseudoscalar vector mesons. An additional rule forbids the decay into two pseudoscalar mesons of all members of a tenfold multiplet that has even parity. (auth)

30557 RENORMALIZATION OF A CP-INVARIANT THEORY. R. Delbourgo (Univ. of Wisconsin, Madison). Nuovo Cimento (10), 32: 1380-3(June 1, 1964).

With reference to the $\Lambda N\pi$ system, it is confirmed that the well-known Feynman rules may still be applied for computation, providing additional subtractions are performed on the parity-breaking contributions to the fermion propagator and vertex function. (auth)

30558 HARMONIC-OSCILLATOR MODEL OF THE SPIN OF THE ω-MESON. J. G. Belinfante (Univ. of Pennsylvania, Philadelphia). Nuovo Cimento (10), 32: 1384-91 (June 1, 1964).

A harmonic-oscillator model of the meson (ω) is analyzed to account for the known fact that the meson (ω) has spin one. Possibilities of generalizing the theory to relativistic resonances are briefly considered. (auth)

30559 A NEW REGGE REPRESENTATION FOR POTENTIAL SCATTERING. M. Kretzschmar (Max-Planck-Institut für Physik und Astrophysik, Munich). Nuovo Cimento (10), 32: 1405-21(June 1, 1964).

For a superposition of Yukawa potentials such that N Regge trajectories enter the right half of the angular-momentum plane a decomposition of the scattering amplitude into N + 2 terms is derived. These are, respectively, the Born term, a background term, and N Regge terms. A Regge term belongs to a specific trajectory and represents the effect of only that part of the trajectory, which lies in the right half of the angular momentum plane. Each Regge term satisfies a Mandelstam representation with a bound-

ary curve for the spectral function as is usual for potential scattering. Moreover, the spectral function is nonvanishing only in a strip, parallel to the t-axis (t is momentum transfer), the width of which is determined by the energy interval for which the corresponding Regge trajectory is in the right half-plane. This corresponds exactly to the new strip concept of Chew, Frautschi, and Mandelstam. Contrary to other Regge representations a Regge term has no unphysical left-hand cuts. A study of the contribution of a given Regge term to the l-th partial wave reveals that the Regge term describes all bound states and resonances that are being caused by the corresponding trajectory. It is shown that the partial-wave projection of a Regge term can be defined throughout the right half of the angular momentum plane. (auth)

30560 BOUND-STATE CONDITIONS. E. G. P. Rowe (University Coll., Cape Coast, Ghana). Nuovo Cimento (10), 32: 1422-31(June 1, 1964).

By reference to some previously proven equivalences, a discussion is given of the bound-state conditions (relations determining the mass and coupling constant of a composite particle) derived by the bootstrap method. No Lagrangian field theory is found in which $Z_1 = 0$ is a condition, but an alternative to it is presented. (auth)

30561 CABIBBO'S TRANSFORMATION AND THE $\Delta I = \frac{1}{2}$ RULE. W. Królikowski (Inst. for Nuclear Research, Warsaw and Univ. of Warsaw). Nuovo Cimento (10), 32: 1448-9(June 1, 1964).

An argument is presented that any unitary transformation induced by weak interactions violating strangeness conservation must have the form of the Cabibbo transformation if these interactions preserve CP invariance. It is shown that nonleptonic weak interactions obeying the $\Delta I = \frac{1}{2}$ rule can be obtained from interactions conserving isospin and strangeness but breaking SU_3 symmetry by means of the Cabibbo transformation. (C.E.S.)

30562 THE APPLICATION OF KOHNS VARIATIONAL METHOD TO THE ELASTIC SCATTERING OF LOW ENERGY NEUTRONS BY DEUTERONS. J. W. Humberston (Univ. of London). Phys. Letters, 10: 207-10(June 1, 1964).

The effect on low-energy n-d scattering phase shifts of possible distortion of the deuteron ground-state wave function by the incident neutron, when a central N-N potential is assumed, was investigated. Doublet and quartet scattering lengths and phase shifts were calculated and compared with results for no distortion. Distortion, apparently, is important in doublet states and is such that the two like nucleons adopt a spatially symmetric configuration. Only a slight dependence of the results on the range of the N-N potential was noted. (D.C.W.)

30563 TRUNCATION BOUNDS ON THE PHASE AND K-MATRIX IN SCATTERING THEORY. W. A. McKinley and J. H. Macek (Rennselaer Polytechnic Inst., Troy, N. Y.). Phys. Letters, 10: 210-12(June 1, 1964).

A general relation for inelastic scattering is given and is used to derive rigorous truncation bounds on the phase in single-channel scattering and on the K matrix in inelastic scattering. (D.C.W.)

30564 FURTHER RESULTS ON THE $\Delta Q = \Delta S$ RULE IN $K^* \beta$ DECAY AND $K_1^0 - K_2^0$ MASS. B. Aubert, L. Behr, J. P. Lowys, P. Mittner, and C. Pascaud (Ecole Polytechnique, Paris). Phys. Letters, 10: 215-19(June 1, 1964).

The validity of the $\Delta Q = \Delta S$ rule was tested by studying beta decay of mesons (K^*). A propane-freon bubble chamber was exposed to an 800-Mev/c K^+ beam, and subsequent meson (K^*) events were observed. The leptonic decay rates and the mass difference Δm were determined. The analysis is described. The results indicate that the data are consistent with the rule. The agreement of Δm with values found in K_1^0 coherent regeneration experiments, however, indicates a satisfactory convergence of the results from regeneration and interference experiments, which had previously been in some disagreement. (D.C.W.)

30565 A DIFFERENTIAL EQUATION FOR THE SELF-ENERGY IN MOMENTUM SPACE. C. G. Bollini and J. J. Giambiagi (Facultad de Ciencias Exactas y Naturales, Buenos Aires). Phys. Letters, 10: 219-21(June 1, 1964).

A nonlinear, second-order differential equation is written for the self-energy function

$$\Sigma(p) = -ie^2 \int \frac{d^4k}{(2\pi)^4} \gamma^\mu D_{\mu\nu}(k) G(p+k) \Gamma^\nu(p+k_1,p)$$

where $G^{-1} = i\gamma \cdot p + m_0 + \Sigma$ and $D_{\mu\nu}$ and Γ^ν are the exact photon propagator and vertex function, respectively. Solutions to the equation are considered. (D.C.W.)

30566 LOGARITHMIC SINGULARITIES IN THE REACTIONS $\pi^- + p \rightarrow n + \pi^- + \pi^+$ AND $p + d \rightarrow He_3 + 2\pi$. V. V. Anisovich and L. G. Dakhno. Phys. Letters, 10: 221-4(June 1, 1964).

It is concluded that the interaction $p + d \rightarrow {}^3He + 2\pi$ has a logarithmic singularity such as that in the amplitude of the $\pi + N \rightarrow N + 2\pi$ interaction. The possibility that these singularities explain the different behavior of the π-π mass distributions at $M_{\pi\pi} \sim 2$ ($M_{\pi\pi}$ is the full energy of two pions in their center of mass system) in the $\pi^- + p \rightarrow n + \pi^- + \pi^+$ and $p + d \rightarrow {}^3He + 2\pi$ interactions is discussed. Experimental and theoretical mass distributions are compared. The effect of the logarithmic singularity on pion production, particularly, is noted. (D.C.W.)

30567 CHARGE CONSERVATION AND THE MASS OF THE PHOTON. B. Zumino (CERN, Geneva). Phys. Letters, 10: 224-6(June 1, 1964).

Using the model of quantum electrodynamics with vanishing spinor mass in a two-dimensional space time, Schwinger showed how a mass could arise in a gauge invariant theory. Some difficulties with his model are discussed. (D.C.W.)

30568 THE OBSERVATION OF TWO $\rho\pi$ RESONANCES. M. Aderholz (Technische Hochschule, Aachen), L. Bondar, W. Brauneck, et al. Phys. Letters, 10: 226-8(June 1, 1964).

Pion mass distributions obtained for the interaction $\pi^+ + p \rightarrow p + \pi^+ + \pi^+ + \pi^-$ at 4 Bev/c revealed separate peaks at masses of 1.08 and 1.32 Bev with widths of about 80 and 100 Mev, respectively. The peaks were established to be associated with the presence of a meson (ρ). Both resonances appear to show η-π decay modes, indicating that for both, $I = 1$ and $J^P = 1^-, 2^+, 3^-$, etc. Strong production of both $N^{*2+}_{3/2\,3/2}$ and ρ^0 was also observed. (D.C.W.)

30569 ON THE PRODUCTION OF THE $\frac{3}{2}\,\frac{3}{2}$ ISOBAR IN 4 Gev/c π^+p INTERACTIONS. J. Bartsch (Technische Hochschule, Aachen), M. Deutschmann, K. Eickel, et al. Phys. Letters, 10: 229-31(June 1, 1964).

The interaction $\pi^+ + p \rightarrow p + \pi^+ + \pi^0$ was studied with emphasis on the production interaction $\pi^+ + p \rightarrow N^{*2+} + \pi^0$. Strong production of the $\frac{3}{2}\,\frac{3}{2}$ isobar was noted. The ρ-exchange model proposed by Stodolsky and Sakurai for N^* production, in which the meson (ρ) is treated in analogy to the gamma ray in pion photoproduction, gave results compatible with experiment for the number of N^*

events and the distributions. Unsatisfactory agreement for the dependence of the cross section on the four momentum transfer was noted, however. Consideration of results obtained at 1.59 Bev/c revealed that the form factor is dependent on the primary energy. (D.C.W.)

30570 PRODUCTION OF NEUTRAL PARTICLES IN π^+-d INTERACTIONS AT 6 Gev/c AND I-SPIN OF f_0. F. Bruyant (CERN, Geneva), M. Goldberg, M. Holder, et al. Phys. Letters, 10: 232-4(June 1, 1964).

The interactions $\pi^+ + d \rightarrow p + p + X^0 \rightarrow$ neutrals and $\pi^+ + d \rightarrow p + p + \pi^+ + \pi^- +$ neutrals were studied. The distribution of missing masses for the first interaction showed large peaks at low mass values and around 1250 Mev, with a slight enhancement between 3 and 4 Bev^2 as well. The 1250-Mev peak was attributed mainly to the neutral decay of f_0. The cross section was estimated to be 115 ± 20 μb and the full width at half maximum, $\leq$180 Mev. Evidence for a strong contribution from the $f_0 \rightarrow 2\pi^0$ decay in the second interaction implies an even I-spin for f_0. (D.C.W.)

30571 THE OBSERVATION OF A PRONOUNCED FINAL STATE INTERACTION IN THE ELECTRO-DISINTEGRATION OF THE DEUTERON. M. R. Yearian (Stanford Univ., Calif.) and E. B. Hughes. Phys. Letters, 10: 234-6(June 1, 1964).

The scattering of electrons from deuterons at 146.9 Mev was measured at a laboratory scattering angle of 135°. The momentum distribution of the electrons shows the elastic peak at 128 Mev, the broad quasi-elastic peak around 112 Mev, and a peak due to interactions of the nucleons in $^3S_1$ and $^1S_0$ states at about 2 Mev below the elastic peak. The inelastic cross section near the disintegration threshold was fitted rather well by the theory of Jankus, who showed that for $^1S_0$ transitions the cross section would peak sharply near the threshold. (D.C.W.)

30572 THE ISOSPIN AND NEUTRAL DECAY OF THE f-MESON. M. Aderholz (Technische Hochschule, Aachen), L. Bondar, W. Brauneck, et al. Phys. Letters, 10: 240-2 (June 1, 1964).

Mass distributions for $\pi^\pm + p$ interactions are shown to support an I = 0 assignment for the f meson. A limit to the 2π decay of the B meson is also derived, and neutral decay of the f meson is discussed in relation to experimental observations. (D.C.W.)

30573 ON THE DISINTEGRATION PROCESSES OF BARYONS BY CASCADES. A. Courau (College de France, Paris). Phys. Letters, 10: 242-5(June 1, 1964). (In French)

A model is proposed in which, without prejudging their structure, the ensemble of the baryons is considered as a series of levels with the nucleon as the fundamental level. The de-excitation of a level is by cascade, competitive between the different intermediate levels, to the fundamental level. The ensemble of the mesons represents the quanta of deexcitation by strong interaction between the different levels. The model suggests the existence, in competition with the peripheral processes, of new inelastic effect, by which some experimental data (π-p) are interpreted. (D.C.W.)

30574 POSSIBLE METHOD TO DETERMINE THE η^0 LIFETIME. E. Celeghini and R. Gatto (Università, Florence and CNEN, Frascati, Italy). Phys. Letters, 10: 245-7(June 1, 1964).

The interaction $\gamma + p \rightarrow n + \eta^0 + \pi^+$ is calculated in view of the possible use of its peripheral contribution for a determination of the meson (η^0) lifetime. The calculations indicate that for incident photon momenta above 2–3 Bev, the peripheral contribution may be easily detected and provide a suitable determination of the lifetime. (D.C.W.)

30575 ELASTIC π^+p SCATTERING AT 4 Gev/c. M. Aderholz (Technische Hochschule, Aachen), L. Bondar, M. Deutschmann, et al. Phys. Letters, 10: 248-9(June 1, 1964).

An analysis of elastic scattering events detected in a bubble chamber study of $\pi^+ + p$ interactions at 4 Bev/c with two charged secondaries is discussed. Evidence for structure in the diffraction peak and for a backward scattering peak was noted. An upper limit on the backward scattering of about $^1/_{150}$ of forward scattering was determined. Data on $\pi^- + p$ are considered. (D.C.W.)

30576 DIRECT OBSERVATION OF THE DECAY MODE $K_2^0 \rightarrow \pi^0\pi^0\pi^0$. B. Aubert (Ecole Polytechnique, Paris), L. Behr, V. Brisson, P. Mittner, P. Petiau, E. Calimani, S. Ciampolillo, C. Filippi-Filosofo, M. Leardini, and A. Sconza. Phys. Letters, 10: 250-1(June 1, 1964).

The decay mode was observed in a freon bubble chamber exposed to a 900-Mev/c K^+ beam. The mesons (K_2^0) were produced in $K^+ + N$ interactions, and the mode was observed by the decay of the mesons (π^0) into three gamma pairs, which subsequently decayed into three electron pairs. Five events with six electron pairs formed from gamma rays coming from the same neutral vertex were observed. Determination of the effective masses of the six gamma systems gave values in good agreement with the accepted value for the K^0 mass. The momentum and direction of the five mesons (K_2^0) were also calculated; each time a possible origin was found. (D.C.W.)

30577 Λ^0 PRODUCTION BY HIGH ENERGY SIGMAS IN PROPANE. V. Bisi, G. Borreani, R. Cester, M. Olivetti, B. Quassiati, G. Rinaudo, and A. E. Werbrouck (Istituto Nazionale di Fisica Nucleare, Turin and Università, Turin). Phys. Letters, 10: 252-4(June 1, 1964).

Six hyperon interactions (4 Σ^- and 2 Σ^+) leading to charged lambda decays were detected in a propane bubble chamber exposed to a 1.15-Bev/c K^- beam. The mean free paths for Σ^+ and Σ^- were found to be 130 cm, within statistical errors, and the $\Sigma^\pm \rightarrow \Lambda^0 (\Sigma^0)$ conversion cross section was estimated to be around 53 mb. (D.C.W.)

30578 POLARISATION OF RECOIL DEUTERONS IN ELECTRON DEUTERON SCATTERING. D. Schildknecht (Universität, Munich). Phys. Letters, 10: 254-6(June 1, 1964).

A calculation of the tensor polarization of the recoil deuteron in electron scattering by polarized deuterons is outlined. Numerical values are included and discussed. (D.C.W.)

30579 DOUBLE SCATTERING CORRECTIONS TO HIGH-ENERGY DIFFRACTION SCATTERING FROM DEUTERONS. David R. Harrington (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 135: B358-64(July 27, 1964).

The eikonal method is used to estimate the double scattering corrections to the differential cross sections for high-energy diffraction scattering from deuterons. By inverting the Fourier-Bessel transform, the correction is expressed in terms of the amplitudes for scattering from free nucleons. Numerical estimates are made for the case of p-d scattering by assuming simple forms for the N-N scattering amplitudes and the deuteron form factor. Corrections to the differential cross sections are about -6% in the forward direction and increase in magnitude with increasing momentum transfer. (auth)

30580 INELASTIC π^-–p INTERACTIONS IN THE ENERGY REGION OF 310 TO 454 Mev. Barry C. Barish,

Richard J. Kurz, Victor Perez-Mendez, and Julius Solomon (Univ. of California, Berkeley). Phys. Rev., 135: B416-31 (July 27, 1964). (UCRL-11257)

The differential cross sections for positive pions, protons, and neutrons from inelastic $\pi^- - p$ interactions at 310 to 454 Mev were measured. The data were obtained with electronic counter systems, which measured the energy distribution of the final-state particle of interest at a series of fixed angles. The results were interpreted in terms of the final states $\pi^+\pi^-n$, $\pi^0\pi^0n$, and $\pi^-\pi^0p$. The total cross sections for these three modes as a function of incident pion energy are in qualitative agreement with the predictions by Schnitzer. A preference is shown for his set of $\pi-\pi$ scattering lengths: $a_0 = 0.65$, $a_1 = 0.07$, and $a_2 = 0.14$ μ^{-1}. The observed neutron distributions correspond to a strong preference for low center of mass system neutron energies in both the $\pi^+\pi^-n$ and $\pi^0\pi^0n$ final states. The effect is not present in the observed proton distributions from the $\pi^-\pi^0p$ reaction, which suggests that it is due to a $I = 0$, $\pi-\pi$ interaction. The π^+ data show the formation of the (3,3) isobar combination of the $\pi^- - n$ system in the $\pi^+\pi^-n$ final state. Analysis in terms of an isobar model indicates the predominance of $I = \frac{1}{2}$ incident state. (auth)

30581 QUARKS, TRIALITY, AND UNITARY SYMMETRY SCHEMES. C. R. Hagen and A. J. Macfarlane (Univ. of Rochester, N. Y.). Phys. Rev., 135: B432-3(July 27, 1964). (UR-875-22)

It is shown that integral eigenvalues of Q/e can be achieved for Gell-Mann's quarks (particles belonging to representations of SU_3 with nonzero triality type) by the introduction of a new additive quantum number for strongly interacting particles and a corresponding alteration of the Gell-Mann–Nishijima formula. A possible framework in which such ideas can be formulated is provided by an extension of SU_3 symmetry to SU_4 or perhaps a higher unitary symmetry. (auth)

30582 NUCLEON-NUCLEON SCATTERING FROM ONE-BOSON-EXCHANGE POTENTIALS. Ronald A. Bryan (Laboratoire de Physique Nucléaire, Orsay, France) and Bruce L. Scott. Phys. Rev., 135: B434-50(July 27, 1964).

Nucleon-nucleon scattering is studied for laboratory scattering energies of 0 to 320 Mev for states with angular momentum $l \geq 1$. The central hypothesis is that the interaction may be represented by a series of one-boson-exchange potentials. An attempt is made to fit the phenomenological models of Lassila and of Hamada and Johnston with the series of one-boson-exchange potentials due to the ρ, ω, π, and η, with the meson-nucleon coupling constants taken as adjustable parameters. It is found that additional attraction is required in the central potentials, and this is provided by introducing two scalar mesons of isotopic spin 0 to 1, respectively. The N-N phase shifts that were determined through phase-shift analysis of the N-N data by several groups are then considered. Reasonable fits to the P, D, and F states are obtained. Because of the r^{-3} behavior of the potentials at the origin, all potentials are set to zero within 0.6 F. This has (surprisingly) little effect in most states but does eliminate bound $^3P_2$ and $^3F_4$ states. The effect of including the ϕ and the relation to other experiments are discussed. (auth)

30583 INTERNAL SYMMETRY AND LORENTZ INVARIANCE. F. Coester, M. Hamermesh, and W. D. McGlinn (Argonne National Lab., Ill.). Phys. Rev., 135: B451-2(July 27, 1964).

The notion of a rigorous internal symmetry implies an over-all symmetry group G that contains the inhomogeneous Lorentz group as a proper subgroup. Such a rigorous symmetry does not automatically require degenerate mass multiplets. But over-all symmetry groups that are compatible with mass splittings are severely restricted as follows. Assume the generators of G are the Lorentz generators and the generators of either a semisimple or a compact Lie group. If the Cartan subalgebra of its semisimple part is Lorentz invariant, then all the generators of the internal symmetry are Lorentz invariant. Therefore, there can be no mass splitting. In particular, if the internal symmetry is SU(3) and T_z (isotopic spin) and Y (hypercharge) are Lorentz invariant, then all the generators of SU(3) are Lorentz invariant. (auth)

30584 CONSEQUENCES OF CROSSING SYMMETRY IN SU_3. K. Itabashi and K. Tanaka (Argonne National Lab., Ill.). Phys. Rev., 135: B452-4(July 27, 1964).

The following processes of 2 octets transforming into 2 octets are discussed on the basis of crossing symmetry: $P + B \rightarrow P + B$, $B + B \rightarrow B + B$, $P + V \rightarrow P + V$, $\cdots$ and their crossed channels, where B, P, and V represent baryons, pseudoscalar mesons, and vector mesons, respectively. The relation between channel amplitudes, the number of independent channel amplitudes, and spin selection rules are systematically obtained. (auth)

30585 THREE-PARTICLE UNITARITY INTEGRAL. Y. S. Kim (Univ. of Maryland, College Park). Phys. Rev., 135: B454-8(July 27, 1964).

Various forms of the production amplitude are proposed which are convenient for the three-particle unitarity integral. Both exact and approximate forms are discussed. It is found that in both cases the final-state configuration can be separated from the over-all kinematics by using discrete variables. Form factors with the three-particle intermediate state are also discussed. (auth)

30586 MIXING EFFECTS FOR ϕ, ω, AND ρ^0 MESONS. John Harte and Robert G. Sachs (Univ. of Wisconsin, Madison). Phys. Rev., 135: B459-66(July 27, 1964). (TID-20395)

A method based on the properties of the propagator which was developed for treating the time-dependent behavior of almost degenerate unstable particles is used to discuss mixing effects in resonance phenomena. General equations for the location of the poles and the mixing of states in the production amplitudes are presented. The method is applied to the mixing of ϕ, ω, and ρ^0 mesons. Mixing coefficients and poles are determined explicitly in terms of the elements of the matrix representing the square of the mass. In particular, an expression is given for the complex amplitude, s, of ϕ, ω mixing; but it is indicated that $\mathrm{Im}\, s \ll \mathrm{Re}\, s$, so that the usual approximation of treating s as real is probably good enough for most purposes. The 2π and 3π production amplitudes due to ρ^0 and ω production are shown to depend strongly on the production mechanism, as already noted by Bernstein. For example it is found that production of the 2π mode will have its maximum at the ω pole in a process dominated by ρ exchange. It is also shown that ρ^0 and ω masses could be taken to be nearly equal, if the apparent splitting of the masses is caused by destructive interference. It is found that, in general, PT invariance implies that the mass matrix is symmetric. (auth)

30587 IMPLICATIONS OF APPROXIMATE SU_3 SYMMETRY AND MASS FORMULAS FOR THE MESONS. F. Guersey (Inst. for Advanced Study, Princeton, N. J.), T. D. Lee, and M. Nauenberg. Phys. Rev., 135: B467-77 (July 27, 1964).

The connection between the limit of perfect SU_3 symmetry and the zero mass approximation for the pseudoscalar

meson octet is discussed. The well-known quadratic mass formula for the pseudoscalar meson octet and the linear mass formula for the baryons are derived. A simple model of strong interaction is presented which leads to two mass formulas for the nine spin-1 mesons: $2M_\phi + M_\rho + M_\omega = 4M_{K^*}$ and $M_\rho \cong M_\omega$. The general invariance property of this model which contains, among others, a baryon octet, a pseudoscalar octet, and a vector nonet is examined. (auth)

30588 $K^-p \to \bar{K}^0\pi^-p$ REACTION FROM 1.0 TO 1.7 Bev/c. Stanley G. Wojcicki (Univ. of California, Berkeley). Phys. Rev., 135: B484-94(July 27, 1964). (UCRL-11138)

A study of the interaction $K^-p \to \bar{K}^0\pi^-p$ over the range of energies from 1.0 to 1.7 Bev/c is summarized. The reaction is shown to be dominated by the $K^{*-}p$ final state from threshold (1.08 Bev/c) to the highest energy available in this experiment. The best values for K^{*-} parameters are shown to be 891 and 46 Mev for the central value and full width of the resonance, respectively. It is shown that the one-pion-exchange contribution dominates the low-momentum-transfer events at the higher energies. Assuming that $T = 3/2$ $K\pi$ interaction is negligible, which is strongly indicated by the data of Galtieri, the $T = 1/2$ $K\pi$ s-wave phase shift is shown to be small, positive, and roughly linear with the center-of-mass momentum in the $K\pi$ system. Influence of other unstable meson and baryon states on this interaction is discussed. (auth)

30589 STUDY OF THE REACTIONS $K^-p \to \bar{K}2\pi N$ FROM 1.2 TO 1.7 Bev/c. Stanley G. Wojcicki, Margaret H. Alston, and George R. Kalbfleisch (Univ. of California, Berkeley). Phys. Rev., 135: B495-9(July 27, 1964). (UCRL-11139)

A study of $\bar{K}2\pi N$ final states from K^-p interactions at 1.2 to 1.7 Bev/c is summarized, with the emphasis on $\bar{K}\pi$ and $\bar{K}2\pi$ systems. It is shown that except for the 1520-Mev Y_0^*, no other resonance contributes markedly to these channels in this energy range. More specifically, there is no evidence for any $J^P = 1^+$ meson of negative strangeness. The branching ratio of the K^* into a κ and a π is shown to be less than 0.2% of its total rate. The cross section for the reaction $K^-p \to \kappa\pi N$ over this range of energies is shown to be less than or equal to a few microbarns. (auth)

30590 VERTEX FUNCTIONS AND THE UNITARITY RELATION. Masakuni Ida (Univ. of Illinois, Urbana). Phys. Rev., 135: B499-507(July 27, 1964).

It is shown that a unitarity relation holds for vertex functions in a form analogous to the one for form factors and that the one-particle irreducible parts of scattering amplitudes satisfy unitarity by themselves. The case of nonrelativistic s-wave scattering with one bound state is also considered. Interrelations among the S matrix, the denominator function, and functions for the bound state, such as the form factor, the propagator, and the vertex function are discussed under certain general restrictions. (auth)

30591 NEW CRITERIA FOR EXCHANGE OF A SPIN-ZERO MESON. Alfred S. Goldhaber (Princeton Univ., N. J.). Phys. Rev., 135: B508-10(July 27, 1964).

An extension of the Treiman-Yang test to provide a criterion for exchange of a spin-zero particle is discussed. (D.C.W.)

30592 VECTOR HARMONICS FOR THREE IDENTICAL FERMIONS. M. Bolsterli (Univ. of Minnesota, Minneapolis and Los Alamos Scientific Lab., N. Mex.) and E. Jezak. Phys. Rev., 135: B510-15(July 27, 1964). (LADC-6258)

The construction and parametrization of the internal wave functions ψ for a system of three nucleons are considered. The wave functions have definite parity and belong to definite irreducible representations of the quantum-mechanical rotation group SU_2 and the permutation group $S_3^{\tau\sigma r}$, where the Pauli principle specifies that ψ must belong to the antisymmetric representation of $S_3^{\tau\sigma r}$. τ, σ, and r are two-valued isospin, two-valued spin, and space coordinates, respectively. (D.C.W.)

30593 PREDICTION OF p-, d-, AND f-WAVE PION-NUCLEON SCATTERING. A. Donnachie, J. Hamilton, and A. T. Lea (Univ. of London). Phys. Rev., 135: B515-39 (July 27, 1964).

A peripheral method is developed for predicting $\pi-N$ phase shifts up to moderate energies. Precise values are given for the p-, d-, and f-wave phase shifts (with the exception of p_{11}) up to 400 Mev, and the general behavior up to around 1 Bev is also predicted. The 600- and 900-Mev π^--p resonances are clearly identified with the D_{13} and F_{15} amplitudes, respectively, and it is probable that the 1.35-Bev π^+-p resonance is in F_{37}. The predictions at 310 Mev select the phase shift set spdf II of Vik and Rugge. The method consists of evaluating the dispersion relation for $F_{l\pm}(s) = f_{l\pm}(s)/q^{2l}$ where $f_{l\pm}(s)$ is the partial-wave amplitude. The factor q^{-2l} suppresses the unknown shorter range parts of the $\pi-N$ interaction. Various means are used to avoid the difficulties arising from lack of knowledge of the inelasticity. The symmetries in spin and isospin of the dispersion relation calculations of the various interactions are examined, together with equivalent model potentials. (auth)

30594 SPIN CORRELATION PHENOMENA IN THE REACTION $\bar{N}_a + N_b \to \bar{Y}_c + Y_d$. Loyal Durand, III, and Jack Sandweiss (Yale Univ., New Haven). Phys. Rev., 135: B540-50(July 27, 1964).

Interactions of the type $\bar{N}_a + N_b \to \bar{Y}_c + Y_d$, where N_a and N_b are nucleons and Y_c and Y_d are hyperons, occur with significant probabilities in the interactions of energetic antinucleons. Pais discussed some consequences for the interaction cross sections and the polarizations of the final particles of the presumed invariance of the relevant strong interactions under the parity and charge-conjugation operations. These considerations are extended to encompass two-particle spin correlations in the $\bar{Y}_c, Y_d$ system. Measurements of the correlation parameters would provide tests for charge conjugation, parity, and CP invariance in the strong interactions of strange particles and could, in addition, be used to check the relation between antihyperon and hyperon decay asymmetry parameters predicted on CPT and T invariance for the weak interactions, that $\alpha_{\bar{Y}} = -\alpha_Y$. Moreover, measurements of the spin correlation parameters would provide valuable information about the spin dependence of the interactions; hence, some tests for the models are proposed for the reaction mechanism. (auth)

30595 RECOUPLING EFFECTS IN THE ISOBAR MODEL. I. GENERAL FORMALISM FOR THREE-PION SCATTERING. Gordon N. Fleming (Univ. of Pennsylvania, Philadelphia and Univ. of Washington, Seattle). Phys. Rev., 135: B551-60(July 27, 1964).

The consequence of elastic unitarity and analyticity for the isobar model of isoscalar three-pion scattering are derived. All recoupling effects are retained, and a real pion exchange is discussed. It is shown that the isobar model may be made to satisfy Watson's theorem. The common origin of both these phenomena is displayed, and the modifications they generate in the partial-wave discontinuity equations are obtained. The N/D equations are derived for the $J = 1^-$ isoscalar amplitude. The effect of recoupling in

the narrow width approximation is demonstrated by a calculation of the effective $\rho-\pi$ phase space and suggests that recoupling is important. (auth)

30596 ANGULAR CORRELATIONS IN THE VECTOR-MESON EXCHANGE MODEL FOR RESONANCE PRODUCTION. Yuan Li and Michel B. Martin (Univ. of Michigan, Ann Arbor). Phys. Rev., 135: B561-5(July 27, 1964).

The vector-meson exchange model for resonance production is used to predict the angular distribution of the decay products of the resonance and of the scattered particle or resonance. Only parity and angular-momentum conservation rules are used in these calculations. The angular correlation functions are given in explicit form. The examples presented are for interactions of type: $\pi + N \rightarrow \omega + N^*$, $\rho + N^*$, and $\pi + N^*$. (auth)

30597 INTERPRETATION OF HIGH-ENERGY LARGE-ANGLE SCATTERING. Kunio Yamamoto (Univ. of Chicago). Phys. Rev., 135: B567-9(July 27, 1964). (EFINS-64-11)

It is shown that if the analytically continued partial-wave amplitude is assumed to have l dependence $a_\pm(s,l) = \sum_{l=0}^{n} C_m^\pm(s) l^m (l+1)^m$ for $l < l_0(s)$ and finite n, the scattering amplitude is bounded by $\exp\{-\text{const}[l_0(s)\ \sin\theta(s)]^{1/2}\}$ at high energies. Here $a_+(s,l)[a_-(s,l)]$ is equal to $a_l(s)$ for even (odd) integer l. The most physical example of this dependence is that in which a central area of the scatterer becomes maximally absorptive. (auth)

30598 BREMSSTRAHLUNG IN ELECTRON-PROTON SCATTERING. E. A. Allton (Stanford Univ., Calif.). Phys. Rev., 135: B570-?(July 27, 1964).

The differential cross section for high-energy electron-proton scattering accompanied by either the emission of photons of various energies or low-energy pions was measured. The dominant process studied was scattering of electrons accompanied by the emission of a single hard photon. The experiment was carried out by observing the spectrum of the inelastically scattered electron without observation of the recoil proton or emitted photon. The differential cross section for this process was computed theoretically by the numerical integration of a formula previously obtained by Berg and Lindner. The result of the integration yielded an approximate formula which expresses the cross section in terms of an "equivalent radiator." This formula was checked against both the more accurate computation and the experiment and found to be in good agreement. The theoretical expression for inelastic electron scattering is given in terms of the experimental measurements of elastic electron-proton scattering. (auth)

30599 DIFFERENTIAL AND TOTAL CROSS SECTION FOR THE REACTION $p + p \rightarrow d + \pi^+$. O. E. Overseth (Univ. of Michigan, Ann Arbor), R. M. Heinz, L. W. Jones, M. J. Longo, D. E. Pellett, M. L. Perl, and F. Martin. Phys. Rev. Letters, 13: 59-61(July 13, 1964).

An experiment to measure the differential cross sections for the reaction $p + p \rightarrow d + \pi^+$ is described. The results are presented for incident proton energies of 1.3, 1.5, 1.7, 2.0, 2.5, and 2.8 Bev, and features of the angular distribution curves are discussed. Total differential cross sections are also presented. (L.B.S.)

30600 STUDY OF S = −2 BARYON SYSTEMS UP TO 2 Bev. Gerald A. Smith, James S. Lindsey, Joseph J. Marray, et al. (Univ. of California, Berkeley). Phys. Rev. Letters, 13: 61-6(July 13, 1964). (UCRL-11456)

Evidence for existence of a 1810-Mev, S = −2 baryon state was found from a study of K^- + p reactions obtained from exposure of the 72-in. hydrogen bubble chamber to a separated beam of K^- at incident momenta of 2.45, 2.64, and 2.70 Bev/c. It is concluded from analysis of Dalitz plots of three four-body final states that the combined three final states involve the production of Ξ^* (1530), which is interpreted as a resonance with parameters, E = 1810 ± 10 Mev and Γ = 70 Mev. An excess of events in the distribution for $\Lambda^0\overline{K}$ in the 1810-Mev region was observed in mass distribution curves of S = 2 pairs from three-body final states. Approximately 22 events, which were ascribed to the 1810 phenomenon in the $\Lambda^0 K\overline{K}$ events, indicated an appreciable decay rate into $\Lambda^0\overline{K}$. Investigations of other properties yield a highly favorable isospin assignment of $\frac{1}{2}$ for the Ξ^* (1810), and spin-parity values of $\frac{3}{2}^+$ and $\frac{5}{2}^+$. (L.B.S.)

30601 K^-p CHARGE EXCHANGE AT 2.00 Bev/c. D. Barge (Brookhaven National Lab., Upton, N. Y.), W. Chu, L. Leipuner, R. Crittenden, H. J. Martin, F. Ayer, L. Marshall, A. C. Li, W. Kernan, and M. L. Stevenson. Phys. Rev. Letters, 13: 69-72(July 13, 1964).

Differential charge-exchange cross section for the 2.00 Bev/c, $K^- + p \rightarrow \overline{K}^0 + n$ reaction was measured. A total of 88 events were observed. Taking into account total escape probability of K_2^0 and neutral mode of decay of K_1^0, as well as a correction for escape probability of K_1^0, the charge exchange cross section was found to be 0.812 ± 0.095 mb for a corrected value of 423 events. The corresponding cross section for the $K^- + p \rightarrow \overline{K}^0$ + all neutrals was found to be 2.72 ± 0.22 mb. Fits to both the elastic-scattering and charge-exchange scattering data, using formulas derived from classical optical model scattering theory, are shown. (L.B.S.)

30602 DECAY MODES OF THE 960-Mev $\eta\pi\pi$ RESONANCE. Laurie M. Brown and Harry Faier (Northwestern Univ., Evanston, Ill.). Phys. Rev. Letters, 13: 73-6 (July 13, 1964).

It is shown that the dominance of the $\eta\pi\pi$ mode implies that the principle mechanism is $\Xi^0 \rightarrow \eta + \sigma$, $\sigma \rightarrow \pi\pi$, where σ is an isosinglet neutral scalar meson. Assumptions are made that the meson Ξ^0 has $T J^{PG} = 00^{-+}$ and that it decays mainly by strong interactions. The decay width is estimated using an extension of the Coleman-Glashow notion of a unitary-symmetric scalar meson coupling strength. Branching ratios into subsidiary decay modes, including electromagnetic modes, are also obtained. (L.B.S.)

30603 LIQUID HYDROGEN TARGET OUT OF POLYSTYRENE. V. I. Petrykhin, Yu. D. Prokoshkin, and V. M. Soroko (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekhn. Eksperim., No. 2, 22-3(Mar.-Apr. 1964). (In Russian)

A liquid hydrogen target composed completely of polystyrene is described. The target can be used for investigating p-p interactions. (C.E.S.)

30604 NUCLEON-NUCLEON SCATTERING AT 10 Mev AND PION-PION RESONANCES. Setsuko Miyachi (Meiji Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), 31: 452-65 (Mar. 1964).

The effects of the meson (ρ) with T = J = 1 and the scalar meson with T = J = 0 (s-wave π-π pair) on N-N scattering amplitudes are investigated. The momentum-transfer dispersion relation for the N-N scattering amplitudes and Cini-Fubini's approximation for the π-N amplitudes are used to calculate the contributions of the resonances as a function of the angle at fixed energy. The dispersion relation is applied to p-p and n-p scattering at 10 Mev. (D.C.W.)

30605 REMARKS ON THE FORM FACTORS IN THE K_{l3} DECAY MODES. Azuma Toda and Mineo Fukawa

(Tokyo Univ. of Education). Progr. Theoret. Phys. (Kyoto), 31: 466-75(Mar. 1964).

The form factors f_+ and f_- are evaluated by the perturbation theory of a Feynmann diagram which has a baryon–antibaryon closed loop. The calculated ratio f_-/f_+ is considerably smaller than experimental results. An attempt is made to explain the data in terms of a resonance or bound state near the threshold for s-wave K-π scattering, which is treated by the N/D method. (D.C.W.)

30606 ON THE EFFECTS OF VECTOR MESONS ON Y*'s. Kazo Nakazawa (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 31: 476-87(Mar. 1964).

The effects of vector meson resonances (ρ, ω, and K*) on Y*'s are investigated. The force due to the exchange of single vector meson are calculated by the lowest order perturbation theory with an effective interaction hamiltonian in which the parameters concerning these mesons are expressed as coupling constants. The coupling constants of $\rho\Sigma\Sigma$ and ωNN interactions are particularly important. The energy levels of Y_0^* and Y_2^* depend heavily on them, and the spin-parity of Y_0^* and/or Y_2^* may not be assigned to $P_{\frac{1}{2}}$. On the other hand, Y_1^* is little affected by them and may be regarded as a resonance of the $P_{\frac{3}{2}}$ state. (auth)

30607 THE BROKEN SYMMETRY AND A SYMMETRICAL SET OF CHARGES IN OCTET THEORY. Takao Tati (Univ. of Kanazawa, Japan). Progr. Theoret. Phys. (Kyoto), 31: 511-12(Mar. 1964).

Expressions for the strong interactions leading to the conservation of three spins under SU_3 symmetry are given, and SU_3-breaking interactions are attributed to interactions leading to the conservations of charge. Three symmetrical charge numbers are defined, and the implications for the SU_3-breaking interactions are considered, together with the relative magnitudes of the charges. (D.C.W.)

30608 ON THE QUADRATIC SPIN-ORBIT FORCE IN p-p SCATTERING. Shoichiro Otsuki (Nagoya Univ., Japan). Progr. Theoret. Phys. (Kyoto), 31: 514-16(Mar. 1964).

An argument for determining the sign and magnitude of the T = 1 quadratic spin-orbit coupling force is presented. The spin is related to the type of π-N coupling. (D.C.W.)

30609 BROKEN SYMMETRY AND k MESON. Masataka Hosoda and Yoneji Miyamoto (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 31: 520-2(Mar. 1964).

The appearance of the 725-Mev meson (κ) with isospin $\frac{1}{2}$ due to the existence of the mass difference between the nucleons and the hyperon (Λ) is discussed within the framework of the Sakata model, using the chain approximation. The meson (κ) is taken to be a scalar particle. (D.C.W.)

30610 THE MESON (B) AND THE GLOBAL SYMMETRY R_8. G. Cocho (Universidad Nacional, Mexico (City)). Rev. Mex. Fis., 13: 7-13(1964). (In Spanish)

By assuming that the $\tau\omega$ resonance (B meson) has spin-parity 1^-, the coupling constants $\gamma^B_{\pi\pi}$, γ^B_{KK}, and $\gamma^B_{\pi\omega}$ were estimated. These values were compared with the ones obtained for the 1^- $^8\rho'$ vecton predicted by R_8 symmetry and good agreement was found. (auth)

30611 MUON PAIR CREATION BY AN ELECTRON AT 0.75 ~ 1.3 Bev. Takao Yamamoto. Sci. Rept. Fac. Lit. Sci., Hirosaki Univ., 10: 10-14(Aug. 1963).

The differential cross section for meson(μ) pair creation by an electron is calculated; numerical results are given for incident electron energies of 0.75, 1.00, and 1.30 Bev. (D.C.W.)

30612 ANALYTICAL PROPERTIES OF PRODUCTION AMPLITUDES AND CHEW-LOW'S METHOD. V. I. Fushchich. Ukr. Fiz. Zh., 9: 277-82(Mar. 1964). (In Ukrainian)

The analytical properties of the contribution to the production amplitude from diagrams were investigated for the process $\pi + N \rightarrow N + 2\pi$ (taking into account all possible permutations of external lines). The conditions are presented under which the contribution to the production amplitude from these diagrams are analytical in the region bounded by an extrapolation ellipse. The threshold and triangular properties of the type 7 diagram are discussed in detail. (auth)

30613 THE THRESHOLD BEHAVIOUR OF PARTIAL WAVE SCATTERING AMPLITUDES AND THE N/D-METHOD. P. Beckmann (Universität, Mainz). Z. Physik, 179: 379-92(1964). (In German)

It is shown that in partial wave dispersion relations the weight function on the unphysical cut must have a certain number of zeros in order to permit the correct threshold behavior of the amplitude. Assuming a solution—not necessarily with correct threshold behavior—of the once-subtracted N/D-equations to exist, the role of the subtraction parameters in repeatedly subtracted N/D equations is studied with particular reference to the threshold behavior. (auth)

Field Theory and Quantum Mechanics

30614 (AERE-R-4646) STRONG INTERACTIONS AND DISPERSION RELATIONS. P. G. Burke, R. J. N. Phillips, and A. E. A. Warburton (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). May 1964. 119p.

After a general introduction to S-matrix theory, including a discussion of invariance principles, perturbation theory is developed as an introduction to dispersion relations, and simple applications of analyticity, pololgy, and peripheralism are considered. The Mandelstam representation and dispersion relations are discussed, with examples. Finally, topics of current interest, viz., Bootstraps, Regge poles, and Unitary Symmetry, are outlined. The notes were prepared for a lecture course at Bristol Univ. for Jan. to Mar. 1964. (auth)

30615 (CEA-R-2400) ETUDE ET COMPARAISON DE QUELQUES METHODES DE CALCUL DU FACTEUR DE TRANSMISSION D'UNE BARRIERE DE POTENTIEL EN MECANIQUE QUANTIQUE. (Study and Comparison of Some Methods for Calculating the Transmission Factor of a Potential Barrier in Quantum Mechanics). Pierre Jamet (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). Apr. 1964. 45p.

Two accurate methods for the calculation of the transmission coefficient of a one-dimensional potential barrier are formulated. The principles of these methods are expressed in a symmetrical form with respect to the two sides of the potential barrier; this constitutes a proof of the fact that the transmission coefficient is path-direction independent. The numerical application is carried out on several examples and the results are compared to those provided by the WKB method. (auth)

30616 (COO-1328-7) QUANTUM EFFECTS IN ELASTIC MOLECULAR SCATTERING. Richard B. Bernstein (Wisconsin. Univ., Madison. Theoretical Chemistry Inst. and Wisconsin. Univ., Madison). June 1, 1964. Contract [AT(11-1)-1328]. 99p. (WIS-TCI-47)

Differences in classical and quantum results for differential cross sections, total elastic cross section, and other

features requiring quantum treatment are discussed. (R.E.U.)

30617 (JINR-P-1638) ANALITICHESKIE SVOISTVA AMPLITUD VO VTOROM PORYADKE NELINEINOI TEORII POLYA. (Analytic Properties of the Amplitudes in the Second Order of Non-Linear Field Theory). M. K. Volkov and G. V. Efimov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 10p.

The unitarity is proved in the second order of the non-linear quantum scalar field theory. The asymptotic behavior of the imaginary part of the amplitudes at high energies is obtained. (auth)

30618 (JINR-P-1658) O POSTROENII KVAZIPOTENTSIALA DLYA SPINORNYKH POLEI. (On a Construction of a Quasipotential for Spinor Fields). G. Desimirov and D. Stoyanov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 9p.

A possibility of constructing the quasipotential by perturbation theory is treated. The basic equation of the quasioptical approach was obtained for the problems in which the retarded interaction is considered to be small compared with the instantaneous one. (auth)

30619 (TID-20720(Paper 1)) EXPLICIT CONSTRUCTION OF ASYMPTOTIC FIELDS. Emil Kazes (Pennsylvania State Univ., University Park). 25p.

Examination of a separable potential model in field theory, when the interaction is attractive enough to produce bound states, shows that the $t = \pm\infty$ limits of the Heisenberg fields do not always have a particle interpretation, but are superpositions of eigenfields. The commutators of the in-fields of particles that are well enough localized to have a finite interaction energy are operators. (auth)

30620 (UCRL-11392) THE SEARCH FOR S-MATRIX AXIOMS. Geoffrey F. Chew (California. Univ., Berkeley. Lawrence Radiation Lab.; and California. Univ., Berkeley). Apr. 30, 1964. Contract W-7405-eng-48. 17p. (CONF-452-3)

From American Physical Society, Washington, D. C., Apr. 1964.

An effort to formulate fundamental laws directly in terms of the S-matrix is discussed. A tentative set of axioms to replace perturbation field theory is presented and discussed. (R.E.U.)

30621 THE WKB METHOD IN THREE DIMENSIONS. Charles L. Critchfield (Los Alamos Scientific Lab., N. Mex.). Am. J. Phys., 32: 542-5(July 1964). (LADC-6107)

The WKB method of solution to Schrödinger's equation is usually applied individually to partial waves of definite angular momentum, i.e., in one dimension. However, the partial differential equation may be solved directly, by this method, and the first two terms are derived for the solution to scattering by a central potential. The resulting cross section is the same as in classical theory. (auth)

30622 RELATION BETWEEN GENERALIZED FOLDY-WOUTHUYSEN AND LORENTZ TRANSFORMATIONS. J. Sesma, J. Biel, and L. M. Garrido (Facultad de Ciencias, Barcelona). Am. J. Phys., 32: 559-62(July 1964).

A relation between a transformation, presented in a preceding paper, which diagonalizes the Hamiltonians of spin 0, ½, and 1 particles, and the Lorentz transformation from the laboratory system to a system in which the particle appears at rest, is shown. A relation between any special Lorentz transformation along the direction in which the particle moves and the extension of the Foldy-Wouthuysen transformations is also shown. (L.B.S.)

30623 A COVARIANT FORMULATION OF CLASSICAL ELECTRODYNAMICS FOR CHARGES OF FINITE EXTENSION. John S. Nodvik (Univ. of Southern California, Los Angeles and TRW Space Tech. Labs., Inc., Redondo Beach, Calif.). Ann. Phys. (N. Y.), 28: 225-319(June 22, 1964).

A covariant formulation of classical electrodynamics for charges of finite extension is developed. The nonelectromagnetic forces necessary for stability are taken into account implicitly by requiring that the charge distribution retain a given shape throughout the course of its motion; a general prescription is given for constructing charge-current densities appropriate to such rigid charge distributions. A detailed treatment of the relativistic kinematics of rotating rigid bodies is presented and application is then made to obtain, from an action principle, the equations of motion for a spherically symmetric charge distribution interacting with an applied field; the associated conservation theorems relating to the linear and angular momentum are discussed. Finally, approximations to the equations of motion are obtained by making perturbation expansions in powers of the size of the charge distribution. (auth)

30624 HIGH ENERGY BEHAVIOR AT FIXED ANGLE IN PERTURBATION THEORY. I. G. Halliday (Cambridge Univ., Eng.). Ann. Phys. (N. Y.), 28: 320-45(June 22, 1964).

The high energy behavior of the planar diagrams in a $g\phi^3$ theory at fixed angle is shown to be dominated by the Born terms. The behavior of the ladder diagrams is calculated in detail. It is then shown that the graphs possessing third spectral functions which give rise to the Gribov-Pomeranchuk singularity and Regge cuts behave like $s^{-\frac{1}{2}}$ as $s \to \infty$ at fixed angle. A set of planar diagrams is also investigated whose behavior on an unphysical sheet is prevented from breaking the Born behavior only by the existence of the Froissart bound. Finally the Bjorken-Wu graphs are shown to behave like $\log^2 s/s$ for all orders. (auth)

30625 TRANSFORMATION OF FLUCTUATIONS IN AN INJECTED-BEAM CROSSED-FIELD DEVICE. R. P. Wadhwa (Univ. of Michigan, Ann Arbor). J. Electron. Control (1), 16: 513-36(May 1964).

Appropriate Llewellyn-Peterson type equations are derived by taking into account the two current-density components in the beam. The final noise transport coefficients are obtained in terms of the initial and tangential velocity components and their time derivatives. Two sets of these coefficients are written in a general form so that the noise transport can be evaluated for several perturbation frequencies and different physical models for which the two-velocity components and their time derivatives are specified. These coefficients are evaluated in the gun region for three physical models and in the interaction region for arbitrary input conditions. For non-cycloiding beams in the interaction region these coefficients are also evaluated for several values of ω_p/ω_C and ω/ω_C. The velocity fluctuations decrease, while the current fluctuations increase as ω/ω_C is increased; and the perturbation amplitude increases as ω_p/ω_C is increased, which is in agreement with other results. The perturbations attenuate in the first part and grow in the latter part of the first half cycloid in the gun region, which is also in agreement with other results. (auth)

30626 THE VECTOR POTENTIAL AND MOTION OF CHARGED PARTICLES IN AXISYMMETRIC MAGNETIC FIELDS. David Stern (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res., 69: 2715-19(July 1, 1964).

From the conventional expansion of a scalar magnetic potential (such as the earth's), an expansion of the vector potential is obtained. This expansion is used for analyzing the motion of charged particles in axisymmetric magnetic fields, with special attention to fields that do not deviate far from a dipole. The results are compared with those of Quenby and Webber. Finally, the relation between Störmer's first integral and the third adiabatic invariant is traced. (auth)

30627 CONVERGENCE OF VIRIAL EXPANSIONS. J. L. Lebowitz and O. Penrose (Yeshiva Univ., New York). J. Math. Phys. (N. Y.), 5: 841-7(July 1964).

Some bounds are obtained on $\mathscr{R}(V)$, the radius of convergence of the density expansion for the logarithm of the grand partition function of a system of interacting particles in a finite volume V, and on $\mathscr{R}$, the radius of convergence of the corresponding infinite-volume expansion (the virial expansion). A common lower bound on $\mathscr{R}(V)$ and $\mathscr{R}$ is $0.28952/(u+1)B$, where $u \equiv \exp\{-\text{Min } s^{-1}\Sigma_{i<j\leq s} 2\varphi(x_i - x_j)|/\kappa T\}$ so that $u \geq 1$, with equality for nonnegative $\varphi(r)$, $B \equiv \int|e^{-\varphi(r)/\kappa T} - 1|\, d^3 r$, and $\varphi(r)$ is the binary interaction potential; the irreducible Mayer cluster integrals have the related upper bounds $\beta_k \leq [(u+1)B/0.28952]^k/k$, [u = 1, when $\varphi(r) \geq 0$]. For potentials with hard cores the maximum density is an upper bound on $\mathscr{R}(V)$, though possibly not on $\mathscr{R}$; an example shows how both $\mathscr{R}(V)$ and $\mathscr{R}$ can be less than the maximum density, even if there is no phase transition. A theorem is proved, analogous to Yang and Lee's theorem on uniform convergence in the complex z plane, defining a class of domains in the complex ρ plane within which the operations $V \to \infty$ and $d/d\rho$ commute. This theorem is used to show that $\lim_{V\to\infty} \mathscr{R}(V) \leq \mathscr{R}$, and that there is no phase transition for $0 \leq \rho < 0.28952/(u+1)B$. (auth)

30628 AN ALGEBRAIC APPROACH TO QUANTUM FIELD THEORY. Rudolf Haag and Daniel Kastler (Univ. of Illinois, Urbana). J. Math. Phys. (N. Y.), 5: 848-61 (July 1964).

It is shown that two quantum theories dealing in the Hilbert spaces of state vectors $\mathscr{H}_1$ and $\mathscr{H}_2$ are physically equivalent whenever there is a faithful representation of the same abstract algebra of observables in both spaces, no matter whether the representations are unitarily equivalent or not. This allows a purely algebraic formulation of the theory. The framework of an algebraic version of quantum field theory is discussed and compared to the customary operator approach. It is pointed out that one reason (and possibly the only one) for the existence of unitarily inequivalent faithful, irreducible representations in quantum field theory is the (physically irrelevant) behavior of the states with respect to observations made infinitely far away. The separation between such global features and the local ones is studied. An application of this point of view to superselection rules shows that in electrodynamics the Hilbert space of states with charge zero carries already all the relevant physical information. (auth)

30629 NOTE ON WIGNER'S THEOREM ON SYMMETRY OPERATIONS. V. Bargmann (Princeton Univ., N. J.). J. Math. Phys. (N. Y.), 5: 862-8(July 1964).

Wigner's theorem states that a symmetry operation of a quantum system is induced by a unitary or an anti-unitary transformation. A detailed proof which closely follows Wigner's original exposition is presented. (auth)

30630 CONTINUOUS-REPRESENTATION THEORY. IV. STRUCTURE OF A CLASS OF FUNCTION SPACES ARISING FROM QUANTUM MECHANICS. James McKenna and John R. Klauder (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Math. Phys. (N. Y.), 5: 878-96(July 1964).

A rigorous development of the continuous representation of Hilbert space by bounded, continuous, multidimensional phase-space functions $\psi(p, q)$ is presented. It is shown that these functions form a closed subspace of $L^2(p, q)$ whose elements are functions and not equivalence classes. Differential properties are investigated, and it is pointed out that there are a multitude of definitions whereby $\psi(p, q)$ possesses continuous derivatives of all orders. In one of these definitions, each $\psi(p, q)$ is proportional to a multidimensional, entire function $f(q - ip)$, establishing a connection between Bargmann's Hilbert space of entire functions and one example of a continuous representation. Attention is devoted to the purely functional characterization of the continuous representation by means of the reproducing kernel as a special case of Aronszajn's general theory. Properties of various operators in a continuous representation are carefully defined. (auth)

30631 LAGRANGIAN AND HAMILTONIAN FORMALISMS WITH SUPPLEMENTARY CONDITIONS. Melvin Schwartz (Adelphi Univ., Garden City, N. Y.). J. Math. Phys. (N. Y.), 5: 903-7(July 1964).

The Takahashi transformation introduces a Hamiltonian formalism in the presence of a single linear supplementary condition imposed on n + 1 coordinates. This transformation is generalized to treat the case when there are N independent linear supplementary conditions imposed on the differentials of n coordinates. It is shown that the generalized transformation leads to true coordinates when the coefficients of the differentials are coordinate independent; otherwise the transformation generally leads to quasicoordinates. More general transformations are discussed, the relation with the method of Lagrange multipliers is established, and some problems which arise in connection with quantization are pointed out. (auth)

30632 MOMENTUM DISTRIBUTION IN THE GROUND STATE OF THE ONE-DIMENSIONAL SYSTEM OF IMPENETRABLE BOSONS. A. Lenard (Princeton Univ., N. J.). J. Math. Phys. (N. Y.), 5: 930-43(July 1964). (MATT-223)

Girardeau showed that an exact analytical formula may be given for the ground-state wave function of a system of one-dimensional impenetrable bosons. Starting with this formula, a mathematically rigorous analysis is given leading to the determination of major features of the momentum distribution in the limit of an infinitely large system. (auth)

30633 A METHOD OF STUDY OF THE SPACE CHARGE EFFECTS OF AN ION BEAM MOVING IN SEPARATED OR SUPERPOSED MAGNETIC AND ELECTROSTATIC FIELDS. G. Burnot (Institut de Physique Nucleaire, Lyon). Nucl. Instr. Methods, 27: 77-87(Apr. 1964). (In French)

An analytical method of perturbation was derived and used which takes into account the space charge effect on an elliptical beam of charged particles moving in a quadrupole magnetic field and an axially symmetric electrostatic field when the two kinds of field are separated or superposed. The results were compared to those obtained by numerical integration. (auth)

30634 EINSTEIN'S CONNECTIONS IN NONHOLONOMIC FRAME. K. Chandrashekhar (Inst. of Theoretical Physics, Warsaw). Nuovo Cimento (10), 32: 1166-81 (June 1, 1964).

For providing a detailed geometrical background of Einstein's unified field theory, Hlavatý has chosen the nonholonomic frame of reference. An explicit form of the

sixty-four affine connections in the nonholonomic frame with the usual notations is given. (auth)

30635 ON THE MATHEMATICAL FOUNDATIONS OF RELATIVISTIC QUANTUM MECHANICS OF PARTICLES WITH VARIABLE MASS. A. H. Klotz (Univ. of Liverpool). Nuovo Cimento (10), 32: 1191-1201(June 1, 1964).

The mathematical formulation of the relativistic quantum theory of particles with variable mass is discussed. Some difficulties arising from it are removed, and it is pointed out that there exists a generalization within the framework of its assumptions. The transformation properties of the space of the new spin operators are considered. It is shown that the second-order wave equation of the theory necessarily involves terms linear in the displacement operators. A suggestion is made concerning an introduction of the isobaric spin space into the theory. (auth)

30636 NONUNIQUENESS IN THE S-MATRIX REDUCTION BY MEANS OF THE ASYMPTOTIC CONDITION. [PART] I. F. Kaschluhn and E. Wieczorek (Humboldt-Universität, Berlin and Forschungsstelle für Physik hoher Energien, Deutsche Akademie der Wissenschaften, Berlin). Nuovo Cimento (10), 32: 1202-16(June 1, 1964).

The reduction formulas for S-matrix elements derived by employing the asymptotic condition on interacting fields are studied for the case of the vertex function in a nonlocal form-factor theory for two interacting scalar fields with nonzero mass. It is shown in first-order perturbation theory that for physical values of the momenta one may especially replace the conventional step function appearing in the standard integral formulas by the modified step function $\theta(x_0 - \alpha|x|)$ with $0 < \alpha < k_0/|k|$ where k represents the four-momentum of the reduced particle in the rest frame of the other one. This means that for such modifications the world-line of the reduced particle but not the light cone is distinguished. However, it is found that the standard as well as the modified integral formulas are not well defined in the sense that they are equivalent to integrals over the energy whose integrands involve the product of a distribution with a nonregular function. This has the consequence that the analytic continuation of the reduction formulas leads to nonunique results. Concluding the local case is considered where the reduction formulas with the standard retarded commutator are distinguished. (auth)

30637 THE CLOSED NORMAL FORM OF THE S-MATRIX IN QUANTUM ELECTRODYNAMICS WITH AN EXTERNAL ELECTROMAGNETIC FIELD. J. Šoln (Inst. "Ruder Boskovic," Zagreb). Nuovo Cimento (10), 32: 1301-5(June 1, 1964).

The differential equation is first established for the S-matrix with respect to the coupling constant which connects Heisenberg field operators with the S-matrix. This form enables one to reduce the S-matrix into the normal form in the case of a quantized Dirac field interacting with an external electromagnetic field. (auth)

30638 QUANTUM STATE OF AN IDEAL PHASE DETECTOR. H. Brunet (Centre de Recherches de la Compagnie Générale d'Electricité, Marcoussis, France). Phys. Letters, 10: 172-3(June 1, 1964).

The state of an ideal phase detector is constructed; the appropriate uncertainty relations are derived. The state obtained is nearly the perfect state of Townes and Serber since $\Delta N \cdot \Delta\phi$, where N is the number of quanta, is very near its optimum value. (D.C.W.)

30639 IDEAL PHASE DETECTOR QUANTUM STATE. J. Harms (Compagnie Générale d'Electricité, Marcoussis, France) and J. Lorigny. Phys. Letters, 10: 173-5(June 1, 1964).

Recently, Brunet proposed a state of the harmonic oscillator in which the phase uncertainty was smaller than ever before ($\Delta\phi \sim 1/\langle n \rangle$). It is shown that such a state corresponds to an optimum of the phase definition. The state determined corresponds almost to the ideal phase detector of Townes and Serber, but it is not a minimum uncertainity state. (D.C.W.)

30640 ON THE INTEGRATION OF MAXWELL'S EQUATIONS, AND CHARGE AND DIPOLE FIELDS. G. N. Ward (Coll. of Aeronautics, Cranfield, Eng.). Proc. Roy. Soc. (London), Ser. A, 279: 562-71(June 16, 1964).

The direct integration of Maxwell's equations for free space using a four-dimensional integral identity constructed for this purpose is demonstrated. The method is applied to the calculation of the electromagnetic fields of moving electric charges and electric and magnetic dipoles. (auth)

30641 EXCITATION OF DENSITY WAVES IN A CONDENSED BOSON SYSTEM. Noboru Takimoto (Univ. of New South Wales, Kensington, Australia). Progr. Theoret. Phys. (Kyoto), 31: 399-411(Mar. 1964).

A dispersion relation for the density waves in a condensed boson system is derived using the generalized Thomas-Fermi method. A critical phenomenon involving the excitation of these waves by particles injected with a given velocity (v) into the system is then discussed. It is shown that, provided the imaginary part of a certain admittance constant is very small, a critical velocity (v_c) can be defined in the same way as was discussed first by Landau; above this value of velocity the system exerts a strong resistive force (F) on the injected particles. It is also shown that, for $0 < x = (v - v_c)/v_c \ll 1$, F is proportional to $\sqrt{x}$, if the Landau spectrum is used for the density waves; and it is proportional to x in the plane-wave approximation. (auth)

30642 INVERSION PROBLEM IN THE MODEL FIELD THEORY. Koichi Nakamura, Taizo Muta, and Hiroshi Ezawa (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 31: 488-508(Mar. 1964).

Under the assumption of the factorizability of the off-shell scattering amplitude, it is shown that the off-shell scattering amplitude can be obtained uniquely from the on-shell scattering amplitude by the use of the three kinds of off-shell unitarity conditions previously derived. It is shown that the factorizable scattering amplitude is nothing but the unified expression of the scattering amplitudes for some model field theories, such as the Lee model, etc. and that the appearance of the Castillejo zeros in the scattering amplitude indicates the existence of elementary particles. The scheme is applied to the n-p scattering in the $^3S_1$-state, and the separable $^3S_1$-potential for the n-p scattering is determined by the mass of the deuteron and the phase shift. (auth)

30643 ON THE THEORY OF THE INFINITESIMAL HOLONOMY GROUP IN THE GENERAL RELATIVITY THEORY. Wolf Beiglboeck (Universität, Hamburg). Z. Physik, 179: 148-60(1964). (In German)

Starting from the infinitesimal holonomy group H_1 of a V^4, (+++−) the spin-holonomy group $\tilde{H}_1 \equiv \bar{\sigma}^1(H_1)$ defined by the covering isomorphism σ: $G \to L_+^\uparrow$ was introduced. In Einstein spaces its real Lie algebra may be replaced by a complex one. With the complex calculus the results of Schell, Goldberg, and Kerr may be reproduced with much simplified proofs. A theorem on non-empty Einstein spaces

is given. A theorem was proved on the connection between the H_1-behavior of a vector (spinor) and its covariant derivative in a V^4. With its help the metrics of a V^4 with given H_1 and $Dim(H_1) < 6$ were obtained; the results agree with those given by Goldberg and Kerr and Cahen and Debever. Additional statements on imperfect holonomy groups are included. (auth)

30644 QUANTUM MECHANICS. VOLUME II. Albert Messiah. From the Series in Physics. Amsterdam, North-Holland Publishing Company and New York, John Wiley & Sons, Inc., 1962. p.507-1136. $8.50.

A review on symmetries and invariance with respect to rotation, approximation methods, relativistic quantum mechanics, and field quantization is presented. (D.C.W.)

30645 METHODS IN COMPUTATIONAL PHYSICS. ADVANCES IN RESEARCH AND APPLICATIONS. VOLUME II. QUANTUM MECHANICS. Berni Alder, Sidney Fernbach, and Manuel Rotenberg, eds. New York, Academic Press, 1963. 278p. $10.00.

Useful methods of current interest for solving problems in quantum mechanics are presented. Most of the presently available schemes for calculating multiple integrals arising in the description of atoms and molecules are covered in the first four chapters. The fifth chapter is devoted to one scheme for handling scattering calculations. The variational numerical approach is analyzed in the last chapter. Separate abstracts are prepared for chapters dealing with the use of the Gaussian function in calculations of statistical and quantum mechanics, atomic self-consistent field calculations by the expansion method, and estimating convergence rates of variational calculations. (L.B.S.)

For abstracts of individual chapters see: 30104, 30433, and 30646.

30646 THE GAUSSIAN FUNCTION IN CALCULATIONS OF STATISTICAL MECHANICS AND QUANTUM MECHANICS. Isaiah Shavitt (Columbia Univ., New York). p.1-45 of "Methods in Computational Physics. Vol. II." New York, Academic Press, 1963.

The pertinent properties of the Gaussian function are treated in detail, and some techniques for the useful introduction of Gaussians in the evaluation of certain types of multiple integrals are described. Two examples are presented; the evaluation of higher virial coefficients in statistical mechanics and the calculation of the interelectron repulsion integral in quantum mechanics. (L.B.S.)

Geophysics

30647 (AFCRL-63-736) MEASUREMENTS OF THE NIGHT SKY RADIATIONS AT THE MAGNETIC EQUATOR, HUANCAYO, PERU. Final Technical Report. Mateo Casaverde R. and Alberto Giesecke M. (Peru. Instituto Geofisico, Lima). Oct. 1963. Contract AF19(604)-7213. 17p. (AD-430957)

Measurements of the night-sky emission at 6300, 5893, and 5577 Å were carried out at various azimuths and altitudes, using a scanning photometer. The analysis and correlation of these data with other geophysical parameters are carried out. (auth)

30648 (AFCRL-64-226) NOTE ON SOME CONSEQUENCES OF ALFVEN'S CONDITIONS FOR INTERPRETING THE VAN ALLEN ZONES AND THEIR MOVEMENTS AS WELL AS DISTANT AZIMUTHAL CURRENTS. Technical Note No. 4. J. Le Maire (Liège. Universite). Oct. 25, 1963. Contract AF61(052)-587. 23p. (AD-430707)

Some consequences of Alfvèn's conditions for interpreting the Van Allen Zones and their movements as well as distant azimuthal currents are discussed. (auth)

30649 (UCRL-7659) SOME ELECTRON SPECTRA IN THE RADIATION BELTS IN THE FALL OF 1962. H. I. West, Jr., L. G. Mann, and S. D. Bloom (California. Univ., Livermore. Lawrence Radiation Lab.). Apr. 13, 1964. Contract W-7405-eng-48. 39p.

A five-channel magnetic electron spectrometer was flown on the U. S. Air Force satellite 1962 βk during the Fall of 1962. Energy channels were provided at 325, 955, 1630, 2400, and 3250 kev. Background was determined from two background channels and from the pitch-angle distributions of the data. Representative spectra were obtained for most of the regions of the magnetosphere. The electron spectra were found to be strongly L-dependent, but usually only slightly B-dependent. Low L-shell data showed a high-energy spectrum characteristic of the injection of fission debris electrons from the Starfish nuclear explosion. The spectra softened with increasing L. Peak fluxes at $L \sim 1.3$ were about 4×10^8 electrons/cm^2-sec for electrons > 300 kev. In December an inventory of electrons > 300 kev for $L < 1.7$ was $4.4 \pm 1.3 \times 10^{24}$. The peak of the outer belt at $L \sim 4.5$ showed spectra that can be presented very approximately as an exponential falling off a factor of e in about 600 kev. At $\lambda \sim 50°$ a typical quiet-period flux for electrons > 300 kev was 7.7×10^6 electrons/cm^2-sec. Transiently trapped electrons were observed. These are electrons that will be precipitated when they drift eastward into the region of the magnetic anomaly in the earth's field. The pitch-angle distributions of these electrons are usually very strongly energy dependent, narrowing with increasing energy. The region $L = 1.6$ to 1.8 also shows marked energy dependence of the pitch-angle distributions. In such regions the spectrum is dependent upon pitch angle. (auth)

30650 ON THE PENETRATION OF THE EARTH'S MAGNETIC FIELD QUADRUPOLE COMPONENT THROUGH IONOSPHERE AND MAGNETOSPHERE. R. Fiebig (Universität, Kiel). Atomkernenergie, 9: 209-218(May-June 1964). (In German)

It was assumed that the 40° deviation of the cosmic-ray longitude effect to the quadrupole component of the earth's magnetic field is caused by a 40° shift of the quadrupole component of the earth's magnetic field itself, by penetrating the magnetosphere or the ionosphere. It is shown that the magnetosphere has no effect, but the ionosphere may have. Because of nonlinearity of the equations of movement an exact proof can, however, only be achieved by detailed numerical methods. (auth)

30651 A DIFFUSION MODEL OF THE TRANSPORT OF RADIATION FROM A POINT SOURCE IN THE LOWER ATMOSPHERE. B. J. Brinkworth (University Coll. of South Wales and Monmouthshire, Cardiff). Brit. J. Appl. Phys., 15: 733-41(June 1964).

An adaptation of neutron diffusion theory, with some concepts from potential theory, is used to develop a simple method for determining the effects of multiple scattering and boundary reflection upon the flux of radiation received from a point source in a nonabsorbing foggy atmosphere. The method, which is supported by experiments at reduced scale, shows that the potentially large enhancement of flux by multiple scattering is offset by a marked dependence upon absorption at the boundaries. (auth)

30652 SATELLITE OBSERVATIONS OF THE GEOMAGNETIC FIELD DURING MAGNETIC STORMS. E. J. Smith (Space Technology Labs., Redondo Beach, Calif.), C. P. Sonett, and J. W. Dungey. J. Geophys. Res., 69: 2669-88(July 1, 1964).

Satellite data and surface magnetograms were used to study the gradual and sudden commencement geomagnetic storms of August 16-18, 1959. Analysis of these data shows that the geomagnetic field was strongly perturbed, but retained its essentially dipolar character out to geocentric distances of 8 earth radii (Re); and that a long-period variation in the distant field coincided with the surface storm field at the surface. The magnitude of the main-phase decrease at $\sim 4R_E$ was ~ 2.5 times larger than at the surface. Variations in the field direction at $\sim 7R_E$ correlate with half-day variations in the horizontal component at the surface and the 3-hour K index. Large irregular field fluctuations with periods exceeding one minute were characteristic of the storm period. The large-scale storm field was qualitatively similar to the disturbance field observed previously on nonstorm days. The disturbance field appeared to evolve from quiet to disturbed conditions and then to gradually recover. (auth)

30653 EVIDENCE FOR MAXIMUM PRODUCTION OF HYDROMAGNETIC EMISSIONS ABOVE THE AFTERNOON HEMISPHERE OF THE EARTH. 1. EXTRAPOLATION TO THE BASE OF THE EXOSPHERE. R. C. Wentworth (Lockheed Missiles and Space Co., Palo Alto, Calif.). J. Geophys. Res., 69: 2689-98(July 1, 1964).

An empirical formula giving the attenuation as a function of the F_2 peak ion density and hydromagnetic-wave frequency was applied to a nine-month data sample of hydromagnetic emissions (quasi-sinusoidal oscillations of the earth's magnetic field in the frequency interval around 1 cps). Under the hypothesis that these signals are attenuated as they propagate downward through the ionosphere as hydromagnetic waves, the amplitude and frequency spectrum above the ionosphere at middle latitudes was derived. (auth)

30654 EVIDENCE FOR MAXIMUM PRODUCTION OF HYDROMAGNETIC EMISSIONS ABOVE THE AFTERNOON HEMISPHERE OF THE EARTH. 2. ANALYSIS OF STATISTICAL STUDIES. R. C. Wentworth (Lockheed Missiles and Space Co., Palo Alto, Calif.). J. Geophys. Res., 69: 2699-2705(July 1, 1964).

The results of part 1 concerning attenuation as a function of F_2 peak ion density and hydromagnetic-wave frequency were applied to correct a number of studies of times of occurrence of hydromagnetic emissions at middle and upper latitudes. It is shown that most of these studies then roughly agree with the recent study by Heacock of data from College, Alaska, which implies a daytime predominance of occurrence. It is concluded that hydromagnetic emissions are preferentially present above the ionosphere at middle and upper latitudes during the afternoon with relative morning : afternoon : night occurrence rates of approximately 3 : 4 : 1. (auth)

30655 SATELLITE MEASUREMENTS OF LOW-ENERGY ELECTRONS IN THE NORTHERN AURORAL ZONE. R. D. Sharp, J. E. Evans, W. L. Imhof, R. G. Johnson, J. B. Reagan, and R. V. Smith (Lockheed Missiles and Space Co., Palo Alto, Calif.). J. Geophys. Res., 69: 2721-30(July 1, 1964).

Particle flux measurements and radio and optical measurements on auroras were made concurrently with detectors aboard a polar orbiting satellite near the northern auroral zone. The incident particle energy deposition was measured in two shielded plastic scintillators with electron thresholds of 2 and 28 kev. Data were obtained for six satellite passes over the auroral zone, and for parts of four passes incident particle information was acquired simultaneously with optical and radio measurements. Large variations in the energy distribution of the precipitating particles were observed. On the basis of the assumption that the incident particles were all electrons, the maximum flux observed in the downward direction was determined to be approximately 100 ergs/cm^2 sec ster of electrons with energy greater than 2 kev. The dominant energy contribution to the auroras was from electrons with energies less than 28 kev. Correlations with ground-based measurements showed that, in at least one rather unusual auroral form and in the regions of low-level luminosity outside discrete forms, electrons of energies less than a few kev carried a significant fraction of the precipitated energy. (auth)

30656 A STUDY OF AURORAL ECHOES AT 19.4 MEGACYCLES PER SECOND. Chester Malik and Jules Aarons (Air Force Cambridge Research Labs., Bedford, Mass.). J. Geophys. Res., 69: 2731-6(July 1, 1964).

Observations of auroral returns at 19.4 Mc/s made with a low-powered transmitter from a geomagnetic latitude of 54°N (dip angle 73°) over a period of three years indicate the presence of field-aligned ionization. Shortly after ground sunset the reflections were observed on 25 to 95 per cent of the days of each month during the period 1961-1963. Although the auroral echoes occur more frequently with increasing magnetic index, they are also recorded during quiet days. Frequency of occurrence shows a peak shortly after sunset throughout the year. The time of maximum activity, the presence of reflections without magnetic storms, and the direction of the echoes lead to the hypothesis that this field-aligned ionization occurs during periods of magnetic field changes. The altitude of the field-aligned variations tends to be 200-400 km during quiet periods and 100 km during disturbed magnetic conditions. (auth)

30657 THE EFFECTS ON RADIO ASTRONOMY OF THE JULY 9, 1962, HIGH-ALTITUDE NUCLEAR EXPLOSION. J. M. Hornby (Cambridge Univ., Eng.). J. Geophys. Res., 69: 2737-45(July 1, 1964).

The equivalent brightness temperatures of the r-f radiation produced by the high-altitude nuclear explosion of July 9, 1962, were calculated. The calculations deal with the intensity to be expected by ground-based stations at high geomagnetic latitudes, by a satellite whose orbit crosses the equatorial plane, and at high frequencies. The results of the calculations are compared with the limiting intensities measurable by modern radio-astronomical techniques. It is shown that at frequencies of a few megacycles per second the artificial radiation must be very near the limits of detection of modern satellite-borne receivers and that it may be a hazard to accurate work on the galactic spectrum below 25 Mc/s. (auth)

30658 SOME IONOSPHERIC MEASUREMENTS WITH SATELLITE-BORNE ION TRAPS. W. B. Hanson, D. D. McKibbin, and G. W. Sharp (Lockheed Missiles and Space Co., Palo Alto, Calif.). J. Geophys. Res., 69: 2747-63 (July 1, 1964).

Two ion traps with plane geometry were flown in polar-orbiting oriented satellites, one in October 1961 and one in April 1962. Several results from these flights are at variance with our present understanding of the ionosphere. The measurements were confined to the altitude region from 200 to 500 km, and on the second flight data were obtained over many complete orbital paths. The measured ion concentrations varied from about 10^6 ions/cm^3 to less than 2×10^3 ions/cm^3, and the vehicle potential varied from <1 v negative to 20 v negative. In general, the nega-

tive potential of the satellite was high when the ion concentration was low, although many exceptions to this occurred. At high latitudes, the data on occasion indicate large horizontal gradients, the ion concentration sometimes changing by factors greater than 2 in a few kilometers; and on one occasion it appeared to change by a factor of at least 50 in a horizontal distance of about 200 km. The temperature of the ions obtained from the ion trap data tends to be higher than that expected from present models of the ionosphere. (auth)

30659 THE HEIGHT OF SCINTILLATION-PRODUCING IONOSPHERIC IRREGULARITIES IN TEMPERATE LATITUDES. J. P. McClure (Univ. of Illinois, Urbana). J. Geophys. Res., 69: 2775-80(July 1, 1964).

The heights of ionospheric irregularities responsible for radio satellite scintillation were directly measured by using spaced receivers on 130 passages of Transit 4A. Observed irregularity heights vary from 90 to 800 km. Most of the irregularities were in the F region between 300- and 400-km height. A significant amount of scintillation was caused by irregularities in the E region near 100-km height. E-region scintillation is most probable at midday F-region scintillation at midnight. Strong positive correlation was found between both E- and F-region scintillation and sporadic-E and spread-F conditions on ionograms. F-region irregularity heights increased, on the average, toward the north. Most individual regions of irregularities were found to have little change of height with latitude. About 33% of the passes showed gradual or abrupt height changes, increasing to the north or south with equal probability, in some part of the pass. Height gradients were seldom uniform for distances of more than 50-100 km. (auth)

30660 NIGHTTIME VARIATIONS OF F-REGION ELECTRON DENSITY PROFILES AT PUERTO RICO. Tatsuo Shimazaki (National Bureau of Standards, Boulder, Colo.). J. Geophys. Res., 69: 2781-97(July 1, 1964).

The origin of the time-dependent variations of nighttime F-region electron density profiles was investigated. Assuming a model atmosphere, the set of parameters that best satisfies the continuity equation over a wide range of height in the F region was determined from observational data for midnight in March 1959. A scale height for atomic oxygen of 70 km and diffusion coefficient of 5×10^9 cm^2 sec^{-1} was obtained for the scale height gradient 0.2 and attachment coefficient 10^{-4} sec^{-1} at 300 km. Then the vertical drift velocities were calculated every ten kilometers for each hour. Two cases are considered: one in which the temperature distribution varies with time, and one in which temperature distribution is constant with time. The first case takes into account the effect of the change in attachment and diffusion coefficient at 300 km due to a change in temperature distribution, and the result shows a very reasonable decrease of temperature (about 15 per cent) during the night, making the drift velocity at higher regions very small. The second case gives a remarkable semidiurnal vertical drift velocity with almost the same phase as that calculated from wind systems by dynamo theory. Both results seem equally realistic, but a combination of the two effects, drift velocity and temperature change, may better explain the observational results. (auth)

30661 STUDY OF THE LOWER IONOSPHERE USING PARTIAL REFLECTION. 1. EXPERIMENTAL TECHNIQUE AND METHOD OF ANALYSIS. J. S. Belrose and M. J. Burke (Defence Research Telecommunications Establishment, Ottawa). J. Geophys. Res., 69: 2799-2818 (July 1, 1964).

The amplitude of weak echoes partially reflected from ionization irregularities in the height range 50-100 km is recorded. By utilizing two frequencies, 2.66 and 6.27 Mc/s, and recording the amplitudes of both the ordinary and extraordinary component waves, information is obtained about electron density and electron collision frequency in this height range under both normal and abnormal conditions. The method of analysis (discussed in detail) is essentially similar to that developed by Gardner and Pawsey, except that the generalized magnetoionic formulas, which take into account the energy dependence of the collision cross section, are employed. (auth)

30662 PERIODIC COVARIATION OF RADIOWAVE ABSORPTION, EARTH CURRENTS, AND OTHER ASSOCIATED PHENOMENA IN THE AURORAL ZONE. R. Parthasarathy and V. P. Hessler (Univ. of Alaska, College). J. Geophys. Res., 69: 2867-71(July 1, 1964).

Periodic variations in the cosmic radio noise level at 27.6 Mc/sec observed at College and Healy, Alaska, were noted to correspond with variations in earth current and magnetogram traces. The intensity of the 5577 Å emission from the zenith also covaried with the same periodicity. The periodic events appear to be confined to a narrow belt of latitude. Possible explanation of the periodic events in terms of hydromagnetic phenomena or Vaisala oscillations is considered. (D.C.W.)

30663 ELECTRON AND ION DENSITY OBSERVATIONS IN THE D-REGION DURING AURORAL ABSORPTION. M. Jespersen (Technical Universitet of Denmark, Copenhagen), O. Petersen, J. Rybner, B. Bjelland, O. Holt, B. Landmark, and J. A. Kane. Planetary Space Sci., 12: 543-51(June 1964).

The results of measurements of electron density and collision frequency distributions in the D-region by three rocket flights from northern Norway are described. A multifrequency propagation experiment using ground-based transmissions and reception in the rocket was performed. All three rockets were fired under conditions of auroral type absorption. In one of the rocket payloads, a d-c probe was included; and the results of these observations are also presented. (auth)

30664 IONOSPHERIC AND MAGNETOSPHERIC ANOMALIES AND DISTURBANCES. J. H. Piddington (CSIRO, Sydney). Planetary Space Sci., 12: 553-66(June 1964).

The magnetosphere contains much more ionization than the F region and interchange must occur. This hydromagnetic pumping is caused by the earth's rotation and also by the polarization electric fields associated with the S_q dynamo field and the polar cap fields. In this way an attempt is made to explain high-latitude anomalies, the seasonal anomaly, the annual anomaly, and the polar anomaly. Ionospheric storms are explained in part by the same mechanisms, provided the magnetosphere is largely depleted of its ionization during the storm. Certain magnetospheric movements which are known to occur during geomagnetic storms could lead to such depletion. (auth)

30665 THE DEVELOPMENT OF GEOMAGNETIC STORMS AFTER A NEGATIVE SUDDEN IMPULSE. Syun-ichi Akasofu (Univ. of Alaska, College). Planetary Space Sci., 12: 573-8(June 1964).

It is shown that the solar plasma flow by itself may be a necessary condition for the development of geomagnetic storms, but not a sufficient condition. Additional factors are needed for the ring current and auroral activity. Examples are given to show that appreciable geomagnetic storms sometimes do not develop until after an abrupt re-

duction of the plasma pressure to the level prevailing before the sudden commencement value. Results obtained by Mariner II are also discussed. (auth)

30666 ON THE HEIGHT OF AURORAL ABSORPTION. [PART] I. Bengt Hultqvist (Goddard Space Flight Center, Greenbelt, Md.). Planetary Space Sci., 12: 579-89(June 1964).

The height distribution of the absorption produced by two different observed electron spectra, $N(E)dE = 5 \times 10^9 \exp(-E/5)dE$ and $N(E)dE = 7 \times 10^4 \exp(-E/41)dE$ and also by the bremsstrahlung from the former was estimated. The results indicate that the absorption in the 60–90 km range, due to hard electron spectra, often may dominate, while the absorption caused by bremsstrahlung is smaller than that due to the primary electrons producing the X-rays. These results are discussed in respect to the height of the absorbing layer and the observed small variation of auroral absorption at sunrise and sunset. (auth)

30667 ON THE ASYMMETRIC DEVELOPMENT OF MAGNETIC STORM FIELDS IN LOW AND MIDDLE LATITUDES. S.-I Akasofu (Univ. of Alaska, College) and S. Chapman. Planetary Space Sci., 12: 607-26(June 1964).

By a detailed analysis of the disturbance field of certain magnetic storms, including that of September 13, 1957, it is shown that there must be a fairly steady current system, partly external and partly ionospheric, which contributes a substantial portion of the asymmetry in the low and middle latitude storm field, independent of the growth and decay of auroral electro-jets. A model electric current system is presented to account for such an asymmetry. It is suggested that there is a gap in the ring current belt on the night side, and that the ring current is closed through the ionosphere. (auth)

30668 THE ABSORPTION OF HYDROGEN LYMAN GAMMA RADIATION BY MOLECULAR NITROGEN. M. Ogawa and R. B. Cairns (Univ. of California, Los Angeles). Planetary Space Sci., 12: 656-7(June 1964).

The results of measurements of the absorption cross section of molecular nitrogen at 972.537 Å are listed, and evidence is cited showing that the Lyman gamma line is not absorbed symmetrically by molecular nitrogen. Therefore, the cross section must be measured very carefully if it is to be used to determine the molecular nitrogen content of the atmosphere. (D.C.W.)

30669 COMMENTS ON "A HYDROMAGNETIC THEORY OF GEOMAGNETIC STORMS" BY J. H. PIDDINGTON. W. I. Axford and C. O. Hines (Cornell Univ., Ithaca, N. Y. and Univ. of Chicago). Planetary Space Sci., 12: 660-1 (June 1964).

Misrepresentations by Piddington (see NSA, 17: 12473) of a previously presented unifying theory of high-latitude geophysical phenomena and geomagnetic storms are corrected. (D.C.W.)

30670 THE ELECTRON CONTENT OF THE IONOSPHERE AT MIDDLE LATITUDES IN SUMMER. G. N. Taylor (Univ. of Manchester, Eng.). Proc. Roy. Soc. (London), Ser. A, 279: 497-509(June 16, 1964).

Measurements of the electron content of the ionosphere obtained from observations of the differential Faraday rotation of moon-reflected signals on two closely spaced frequencies are described. Accurate values of the electron content on many successive days near the summer solstices of 1960 and 1961 are presented and are compared and contrasted with similar measurements made in the winter of 1960. The diurnal variations of electron content, short-period irregular fluctuations in electron content, equivalent slab thickness and top-to-bottom ratio are all found to differ from those observed in winter. The middle latitude seasonal anomaly is found to be less prominent in the electron content than in the maximum electron density. (auth)

30671 PHYSICS OF THE EARTH'S OUTER SPACE. S. K. Mitra. Sci. Cult. (Calcutta), 29: 314-29(July 1963).

Properties of the exosphere, outer ionosphere, whistler phenomena, geomagnetic fields, interplanetary magnetic fields, solar magnetic fields, and solar corpuscular emissions, are briefly outlined. The magnetic effects of the solar wind and the Van Allen belts are also discussed. A bibliography of 38 references is included. (C.E.S.)

30672 THEORETICAL SPECTRA OF BACKSCATTER FROM PARTIALLY IONIZED REGIONS. O. Buneman. 9p. (CONF-471-16)

From American Physical Society 5th Annual Meeting, San Diego, Calif., Nov. 1963.

In order to predict atmospheric backscatter spectra in the presence of neutrals and of frequent collisions (lower ionosphere), a model of the collision process was used in the theory. Each of the three species (neutrals, ions, and electrons) was described by a Boltzmann equation with relaxation terms to simulate collisions of the species with itself, and with the other two species. (auth)

Low Temperature Physics

Refer also to abstracts 30227 and 30238.

30673 (SSD-TDR-63-311) ELECTRONICS RESEARCH PROGRAM—LOW-TEMPERATURE ELECTRONICS. Semiannual Technical Report, January 1–June 30, 1963. F. L. Vernon, Jr. (Aerospace Corp., El Segundo, Calif.). Dec. 6, 1963. Contract AF04(695)-169. 17p. (AD-428328; TDR-169(3250-13)TR-1)

Research in low-temperature electronics consisted primarily of measurement of the performance of critical current-critical field (I_c-H_c) characteristics of annealed niobium wire specimens. The peak effect in the I_c-H_c characteristics of annealed niobium wire specimens. The peak effect in the L_c-H_c characteristics occurred only for H perpendicular to the sample axis (and the current flow) and only for samples annealed at 1400°C and above. For fields parallel to the current, an anomalous resistance was noticed for fields and currents well within the values which usually allow the sample to be superconducting. This island effect does not have a satisfactory explanation. Correlation of the field at which the peak effect occurs and the H_{c2} of the Abrikosov theory show satisfactory agreement and indicate that niobium is intrinsically a superconductor of the second type. Some limited experimental work was performed on thin filamentary superconductors. (auth)

30674 MAGNETIC SUSCEPTIBILITY OF A THIN SUPERCONDUCTING FILM. S. J. Krieger (Carnegie Inst. of Tech., Pittsburgh) and A. E. Glassgold. Phys. Rev., 135: A564-7(Aug. 3, 1964).

The weak-field magnetic susceptibility of a thin superconducting film is calculated with a microscopic theory based on the work of Bardeen, Cooper, and Schrieffer. The finite sample size is taken into account by forming Cooper pairs from one-electron states whose wave functions vanish at the film boundary. Although the excitation spectrum of the superconductor remains essentially unchanged by this discrete quantization, the weak-field magnetic susceptibility is found to have a considerably lower value than previous theoretical estimates. (auth)

30675 SPECIFIC HEAT OF MERCURY AND THALLIUM BETWEEN 0.35 AND 4.2°K. B. J. C. van der Hoeven, Jr. and P. H. Keesom (Purdue Univ., Lafayette, Ind.). Phys. Rev., 135: A631-7(Aug. 3, 1964).

The specific heat of mercury and thallium were measured between 0.35 and 4.2°K. In the normal state below 0.7°K the mercury results are given by: $C_n = 1.79T + 5.23T^3$ mJ/mole degree. The coefficient α of the T^3 term corresponds to a value of the Debye parameter Θ_0 of 71.9°K. For temperatures higher than 0.7°K, the lattice specific heat deviates above the T^3 law. A plot of $\Theta(T)$ is given. Below 0.6°K, the specific heat of thallium in the normal state is given by: $C_n = 1.47T + 4.03T^3$ mJ/mole degree. The corresponding value of Θ_0 is 78.5°K. Above 0.6°K, the lattice specific heat of thallium shows a deviation below the pure T^3 law, a result contrary to that found for most solids. This would imply a deviation in the dispersion curve above the linear portion. A similar effect was observed in the specific heat of graphite which was explained on the basis of bond-bending modes of vibration. It is suggested that similar modes may explain this behavior for thallium. In the superconducting state the specific heat of both materials can be represented by a sum of the normal lattice term and a superconducting electronic term C_{es} of the form $a\gamma T_c \exp(-bT_c/T)$. For mercury, values are obtained for a = 15 and b = 1.64 with $T_c = 4.16$°K; for thallium a = 9 and b = 1.52 with $T_c = 2.38$°K. In the case of thallium the critical field as a function of temperature $H_c(T)$ is determined, with $H_c(0) = 176.5$ G. (auth)

30676 MEAN SQUARE FORCE IN LIQUID ARGON AND SEPARATION FACTOR OF ISOTOPES. G. Casanova (Universitâ, Geneva), A. Levi, and N. Terzi. Physica, 30: 937-47(May 1964).

The relation between the separation factor in isotopic phase equilibria and the mean square force in the two phases is applied to the liquid-vapor equilibrium of argon isotopic mixtures, and a comparison is made with mean square forces theoretically deduced from potentials and distribution functions. It is found that only distribution functions obtained from Percus and Yevick's theory and hypernetted chain integral equations or from Monte Carlo calculations give a satisfactory temperature dependence. A residual 20% discrepancy between theory and experiment is tentatively attributed to the Lennard-Jones potential, and the possibility that varying the potential could improve the agreement is considered. The results generally indicate either a variation of the potential between zero and the minimum, and therefore a smaller σ, or a substantial contribution of three-body forces. (auth)

30677 MAGNETIC SUSPENSION OF SUPERCONDUCTORS. L. V. Lazareva. Pribory i Tekhn. Eksperim., No. 2, 181-4(Mar.-Apr. 1964). (In Russian)

Experimental investigations of the suspension of superconducting spheres in magnetic fields produced by various sources are reported. (tr-auth)

30678 DEVELOPMENTS IN SUPERCONDUCTIVITY. Douglas Finnemore (Ames Lab., Ames, Iowa). Proc. Iowa Acad. Sci., 70: 387-91(1963). (IS-656)

The main experiments leading to the present understanding of superconductivity are reviewed. (auth)

30679 EFFECT OF MAGNETIC FIELDS ON HEAT TRANSPORT IN SUPERCONDUCTORS. Kazumi Maki (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 31: 378-87(Mar. 1964).

The thermal conductivity of a superconducting thin film in magnetic fields is calculated by the use of the thermal Green's functions. It is shown that the anisotropic terms of the order of $1/\xi_0$ due to the induced current flow, vanish when l is short, where l is the electronic mean free path and ξ_0 is the coherence length of the electron pair. (auth)

30680 MAGNETIC FIELD DEPENDENCE OF THE ENERGY GAP AND THE CURRENT DENSITY FOR A SUPERCONDUCTOR. Toshio Tsuzuki (Osaka Univ.). Progr. Theoret. Phys. (Kyoto), 31: 388-98(Mar. 1964).

The decrease of the energy gap for a superconductor at finite temperatures in a static magnetic field is calculated up to the second order in the field strength in both the London and Pippard limits. In the London limit, terms depending on the square of the Fourier component of the vector potential in the medium appear, and their temperature dependence near absolute zero is determined. The Ginzburg-Landau equation for a London superconductor is extended, obtaining a new term. (D.C.W.)

30681 JOSEPHSON EFFECT IN LIQUID He II. Toshihiko Tsuneto (Osaka Univ.). Progr. Theoret. Phys. (Kyoto), 31: 516-18(Mar. 1964).

Using the theory of an interacting Bose gas in the low density limit, it is shown that for two bulk systems of He II connected by a specified junction, there are processes by which flow between the systems can occur without any difference in their chemical potentials (without pressure head). The contributions of the processes are given, and difficulties in observing the effect are noted. (D.C.W.)

30682 EFFICIENT BULK TRANSFER OF LIQUID HELIUM AS A SUPERFLUID. W. F. Giauque (Univ. of California, Berkeley). Rev. Sci. Instr., 35: 904-5(July 1964).

An efficient method for the bulk transfer of liquid helium is outlined. The liquefied gas at its boiling point is transferred into a container being pumped under greatly reduced pressures. During the transfer a transformation from helium I to helium II is accomplished. (C.E.S.)

30683 WIDE RANGE MAGNETIC FIELD MEASUREMENTS AT 4.2°K. M. S. Lubell and B. S. Chandrasekhar (Westinghouse Electric Corp., Pittsburgh). Rev. Sci. Instr., 35: 906-8(July 1964).

Magnetic field measuring devices that operate at liquid helium temperatures and can be used to continuously monitor the field intensity of superconducting magnets are discussed. Devices that use magnetoresistance and the Hall effect are considered. The characteristics of the transverse magnetoresistance of high purity copper and bismuth wire and the Hall effect of InAs are investigated. The pertinent features of these devices are compared. (C.E.S.)

30684 ROLE OF INSULATIONS IN A SUPERCONDUCTING MAGNET. Tadao Fukuroi and Tetsuo Fukase. Sci. Rept. Res. Inst., Tohoku Univ., Ser. A, 15: 297-303 (Dec. 1963).

Two types of superconducting magnets, whose insulating layers inserted between every successive superconducting winding layer consist of Mylar sheets in one and metallic copper foils in the other, were examined. The former gives a comparatively definite magnetic field with regard to the exciting current but is liable to be damaged. The latter shows a large magnetic hysteresis owing to the intra- and inter-layer persistent eddy currents between successive layers of windings, but is not damaged by the super- to normal-phase transition. (auth)

30685 EFFECT OF ANISOTROPY ON THE PROPERTIES OF SUPERCONDUCTORS. B. T. Geilikman and V. Z. Kresin (Moscow State Correspondence Pedagogical Inst.). Soviet Phys. Solid State (English Transl.), 5: 2605-11 (June 1964). Translated from Fiz. Tverd. Tela, 5: 3549-59(Dec. 1963).

An anisotropic model of a superconductor is considered. Two types of Fermi surfaces are investigated: closed (ellipsoid) and open (cylinder). Formulas are obtained which describe the dependence of the energy gap on direction. The effect of anisotropy of the gap on the electromagnetic and thermo-dynamic properties of superconductors is considered. (auth)

30686 RECENT DEVELOPMENTS IN SUPERCONDUCTIVITY. P. Grassmann (Eidgenossische Technische Hochschule, Zurich). Sulzer Tech. Rev. (Switz.), 45: 183-6(1963).

After an explanation of the difference between ideal and high-field superconductors, an account is given of the generation of strong, constant magnetic fields with the aid of superconducting solenoids. Fields of over 10^5 gauss can be attained in a small volume. Many technical difficulties still have to be overcome, however, before high and extensive magnetic fields, such as are urgently needed for magneto-hydrodynamic generators, bubble chambers, and cyclotrons, can be produced cheaply and reliably by this method. Research into superconducting information storage cells (cryotrons) seems to have suffered a setback as a result of the recent development of magnetic storage cells. (auth)

30687 MAGNETIZATION OF Nb_3Sn FILMS IN TRANSVERSE FIELDS. J. J. Hanak (RCA Labs., Princeton, N. J.). 33p. (CONF-524-12)

From American Institute of Mining, Metallurgical and Petroleum Engineers Annual Meeting, New York, Feb. 1964.

Magnetization measurements in fields transverse to the film plane have been made as a function of film geometry on 2.25-μ thick Nb_3Sn films vapor-deposited on platinum foil. The specimens were in the shape of discs with the superconducting film subdivided into a varying number of concentric discs. Drastic differences in magnetic shielding and trapping have been observed as a function of subdivision, with a maximum occurring at intermediate ring widths. The occurrence of flux jumps has been also investigated and it has been confirmed that flux jumps are thermally activated. On the basis of these results a 60-kgauss permanent magnet has been constructed by the use of the Nb_3Sn discs and copper foil discs in a laminar stacking. The resulting composite cylinder combines the high critical current density of Nb_3Sn with the high conductivity of copper, which are the properties necessary to obtain stable high fields in a compact device (2.54 cm OD, 0.508 cm ID, and 2.1 cm long). (auth)

Neutron Physics

Refer also to abstracts 30086 and 30735.

30688 (N64-14946) DAMPING THEORY AND ITS APPLICATION TO NEUTRON SCATTERING BY ANHARMONIC CRYSTALS. A. Z. Akcasu and R. K. Osborn (Michigan. Univ., Ann Arbor). [1963]. 75p.

The scattering of slow neutrons by an anharmonic crystal is considered. The differential scattering-cross-section formula is first obtained for an arbitrary macroscopic medium, and then applied to a crystal. Explicit formulas for the width and the shift of the observed peaks in the energy spectrum of the inelastically scattered slow neutrons by crystals are obtained, and compared in the case of a single-phonon event to those by Maradudin and Fein. It is found that the shift formulas agree exactly at all temperatures, whereas the width formulas agree only in the zero temperature limit. The discrepancy in the width formulas at finite temperatures is discussed in terms of the concept of phonon lifetime. The application of the line shape theory to the interpretation of the optical experiments is also discussed. (auth)

30689 (JUL-158-ST) UBER DIE MESSUNG VON FLUSSDICHTEN UND DOSISLEISTUNGSAQUIVALENTEN INTERMEDIARER NEUTRONEN AUSSERHALB DER ABSCHIRMUNG VON NEUTRONENQUELLEN. (On the Measurement of Flux Density and Dose Rate Equivalent of Thermal Neutrons Outside the Shielding of Neutron Sources). Dieter Nachtigall (Kernforschungsanlage, Julich, Germany). Apr. 1964. 138p.

The flux density in the intermediate and fast neutron energy range (0.5 ev to 7 Mev) can be determined independently of energy and direction with the newly developed 3-sphere method. The fraction of intermediate neutrons to the total neutron dose rate equivalent can be determined with the difference method. Both methods require no assumptions on the energy distribution of the neutrons in the intermediate range. Measurement methods for the determination of the neutron flux density and the neutron dose rate equivalent, which assume a 1/E distribution in the intermediate range, are, in general, not applicable outside the shielding of the neutron source. The fraction of intermediate neutrons to the total neutron dose rate equivalent can amount to more than 90%. Neutron dosimeters, which are dose proportional in the intermediate range, yield outside the shielding of neutron sources values that permit no conclusions on the radiation burden of exposed persons. The fraction of thermal neutrons to the total neutron dose rate equivalent is, in general, <5%. No conclusions on the ratio of the magnitude of the γ dose rate to the magnitude of the neutron dose rate equivalent could be made. Structure factors and flux density elimination cross section which are concerned with the intermediate neutron energy range can be determined with the three-sphere method. They were measured for Po, Be, and mock fission neutrons for various new shielding materials. The effect of shielding material can be described by dose rate elimination cross sections. It is not possible to obtain from nuclear trace values outside the shielding representative personal doses. (tr-auth)

30690 (ANL-Trans-42) SOURCE OF "COLD" NEUTRONS FOR THE STUDY OF THE DYNAMICS OF CONDENSED STATES OF SUBSTANCE ON THE REACTOR IRT OF THE INSTITUTE FOR ATOMIC ENERGY NAMED AFTER I. V. KURCHATOV. M. G. Zemlyanov, S. P. Mironov, M. I. Pevzner, V. P. Stepanov, and N. A. Chernoplekov (Akademiya Nauk S.S.S.R. Institut Atomnoi Energii). Translated by Elmar K. Wilip (Argonne National Lab., Ill.). 1963. 9p.

The study of the dynamics of the condensed state of substance by the method of inelastic scattering of cold neutrons requires a high-intensity beam of cold neutrons. The assembly used in the IRT-reactor of the IAE provides a flux of cold neutrons at the location of the sample equal to 5×10^6 neutrons/cm^2 $\times$ sec. For purposes of an intensity increase at the redesigning of the IRT-apparatus the construction of a special source of cold neutrons was provided for, which consists of a moderator area adjoining the active zone of the reactor and which can be cooled to low temperatures. For the creation of an optimum flux of neutrons in the zone of the cooled moderator, the latter is surrounded by a beryllium metal covering. The feasibility of the use of a beryllium cylinder or a cylinder made of a hydrogen containing material which is flushed with liquid nitrogen or neon as a cooling moderator is discussed. Neutron-physical

estimates, data from thermotechnical and neutron-physical experiments on a model assembly and its construction scheme are presented. It is believed, that the described assembly will replace the thermal column of the IRT-apparatus in the IAE. (auth)

30691 DIFFUSION LENGTH OF THERMAL NEUTRONS IN WATER BETWEEN 24 AND 82°C. C. B. Besant and P. J. Grant (Imperial Coll. of Science and Tech., London). Brit. J. Appl. Phys., 15: 691-5(June 1964).

The diffusion length of thermal neutrons in water was measured at various temperatures between 24 and 82°C, using an $^{124}Sb-Be$ (25 kev) source. The experiments were interpreted by a theoretical two-group model, one group referring to neutrons of thermal energy and the other group to neutrons of epithermal energy. The diffusion length L, corrected to unit density, and the absolute temperature T, were found to be related by the expression $L\rho/\rho_0 = \text{constant} \times T^{0.487 \pm 0.026}$. (auth)

30692 AGE CALCULATIONS USING FERMI CONTINUOUS SLOWING DOWN MODEL. M. A. J. Rathur (Imperial Coll. of Science and Tech., London). Brit. J. Appl. Phys., 15: 697-700(June 1964).

A method for calculating ages of monoenergetic and fission source neutrons to any required energy in a moderating medium is described. The method is based on the Fermi continuous slowing down model with a first-flight correction. The results obtained from a program MAFAC, based on this method, for nonhydrogenous media, D_2O, and pure hydrogen are in good agreement with Monte Carlo calculations. (auth)

30693 SEPARATION OF THERMAL AND INTERMEDIATE NEUTRONS. C. Hyver. Bull. Inform. Sci. Tech. (Paris), No. 81, 5-8(Mar. 1964). (In French)

The importance of separating thermal and intermediate neutrons is explained. The theory of filters is presented and the way in which they may be calculated is discussed. Results of such calculations are given and cadmium and gadolinium cases discussed. (auth)

30694 TEMPERATURE MEASUREMENTS OF THERMAL NEUTRON SPECTRA. R. Lloret (CEN, Grenoble, France). Bull. Inform. Sci. Tech. (Paris), No. 81, 9-11 (Mar. 1964). (In French)

The meaning of the effective temperature of a thermal neutron spectrum, and some methods for its determination are discussed. Experimental results obtained with the activation detector pair lutetium-gold in the core and reflector of the swimming-pool reactor Mélusine are presented. (auth)

30695 REACTIONS USED FOR ABSOLUTE MEASUREMENTS. PREPARATION OF DETECTORS. A. Charbonnel and M. Thierry. Bull. Inform. Sci. Tech. (Paris), No. 81, 17-20(Mar. 1964). (In French)

It is shown what the characteristics of the ideal detector should be. For each substance employed (gold, indium, manganese, or cobalt), the nuclear constants required for their use are given. The production processes starting from commercially available materials are described. (auth)

30696 IN-TIME INTEGRATED THERMAL NEUTRON FLUXES BY ACTIVATION METHODS. A. Charbonnel. Bull. Inform. Sci. Tech. (Paris), No. 81, 27-30(Mar. 1964). (In French)

The necessity of integration for measurement of thermal neutron flux times is justified. The principle of the method and practical and theoretical limits are given. It is shown, for the case of cobalt, the way in which the theoretical limits arise and what the general rules to be respected for the irradiations are. The measurement method and the apparatus used are described. (auth)

30697 A SIMPLE METHOD FOR THERMAL NEUTRON DISTRIBUTION ANALYSIS. Sándor Deme. Magy. Tud. Akad. Kozp. Fiz. Kut. Int. Kozlemen., 12: 151-7(1964). (In Hungarian)

A method based on activation autoradiography is described by which the analysis of the radial intensity distribution of thermal neutrons can be rapidly performed even in a wide intensity range. The intensities coverable with the use of copper and gold foils are about 5×10^3 to 10^{12} neutrons/cm^2 sec. The relative accuracy of the analysis is 5 to 10% and the resolving power is better than 1 mm. This method was used to analyze the radial distribution of the collimated thermal neutron beam from one of the horizontal channels in the VVRS reactor. For illustration, some results of this measurement are given. (auth)

30698 EIGENFUNCTION ANALYSIS OF THERMAL-NEUTRON SPECTRA. M. J. Ohanian and P. B. Daitch (Rensselaer Polytechnic Inst., Troy, N. Y.). Nucl. Sci. Eng., 19: 343-52(July 1964). (TID-19520)

Numerical solutions of the time-dependent thermalization problem in infinite 1/v poisoned media as well as in finite media in the diffusion approximation were obtained using an eigenfunction expansion of the neutron-density function in a discrete-energy representation. This eigenfunction method is compared with a method based on direct integration of the Boltzmann equation using a discrete-energy mesh for the scattering integral and a first-order Taylor series for the time integration. Both methods of calculation gave the same results where compared in the area of time-dependent and steady-state spectra. The Wigner-Wilkins Mass-1 and Nelkin scattering models were used with particular emphasis on the computation of time-dependent, asymptotic, steady-state spectra and diffusion parameters and the determination of their sensitivity to the scattering kernel. It is found that time-dependent spectra are rather sensitive to the scattering kernel, particularly at times of the order of a few microseconds after the introduction of a neutron pulse in the case of hydrogenous moderators. The eigenvalues and eigenfunctions for both realistic scattering kernels show the characteristics predicted for simpler analytic models. Both discrete and continuum eigenvalues were found with the eigenfunctions corresponding to the continuum eigenvalues exhibiting a characteristic singular behavior. An interpolation scheme to determine steady-state spectra in hydrogenous moderators is also presented. The method, which is based on interpolating in the reciprocal of the infinite-medium neutron lifetime, gives very good agreement with directly computed spectra in the range of 200 to 15 microseconds lifetime. A perturbation method based upon the infinite-medium eigenfunctions is used to compute diffusion parameters for the decay constant in water; this method, through terms in B^4, yields the decay constant to better than 1% in comparison with the exact diffusion theory result for $B^2 = 1.0\ \text{cm}^{-2}$. (auth)

30699 A SOLUTION OF THE THERMAL-NEUTRON MILNE PROBLEM BY PERTURBATION THEORY. M. M. R. Williams (Univ. of Birmingham, Eng.). Nucl. Sci. Eng., 19: 353-8(July 1964).

Corrections to the extrapolation distance and angular emergent distribution for the Milne problem were obtained by means of a perturbation method. The exact solution for a simple kernel was taken as the unperturbed state, and the method was applied to more realistic scattering models:

numerical results are given for hydrogen gas. By means of a combined use of numerical and analytical methods some very accurate values were obtained for the emergent angular energy spectrum for the Milne problem in the case of hydrogen gas. (auth)

30700 SPECTRAL DISTRIBUTION OF NEUTRONS IN THE VICINITY OF A RESONANCE. Rubin Goldstein (Univ. of California, Berkeley). Nucl. Sci. Eng., 19: 359-62(July 1964).

The failure of the standard slowing-down solutions to reproduce the detailed flux distribution both in and far below a resonance is discussed. To first order, the neutron distribution in energy is explicitly symmetric about the resonance center. Higher-order approximations, however, reveal the asymmetry in the spectral distribution. The direction of the spectral shift, as well as the degree of asymmetry, depends on the resonance parameters. There is, in particular, a competition between absorption and scattering in the resonance which directly affects the spectral asymmetry. The asymptotic distribution far below the resonance is unity instead of equal to the resonance escape probability. This difficulty may be overcome by formulating the problem in terms of the Placzek solution. (auth)

30701 ON THE VARIATIONAL METHOD APPLIED TO THE MONOENERGETIC BOLTZMANN EQUATION. Janusz R. Mika (Inst. of Nuclear Research, Warsaw). Nucl. Sci. Eng., 19: 377-8(July 1964).

The separation of the non-self-adjointness from the monoenergetic Boltzmann equation is discussed. The proper boundary terms that yield the boundary conditions corresponding to the adjoint Boltzmann equation are derived. (C.E.S.)

30702 EVALUATION OF ALBEDO OF NEUTRONS FOR SLAB WALL. Pawel Rafalski (Inst. of Nuclear Research, Swierk, Poland). Nucl. Sci. Eng., 19: 378-80(July 1964).

A neutron beam incident on a wall is considered. The effects of scattering in the wall are estimated by considering multiple scattering. The ratio of the current of neutrons emerging from the surface of the wall to the incident current is evaluated. It is assumed that the scattering is isotropic and that there is no appreciable energy degradation of neutrons. (C.E.S.)

30703 ERRORS IN MEASURING THE DEGREE OF POLARIZATION OF A SLOW NEUTRON BEAM BY THE METHOD OF SHIMS. B. G. Erozolimskii, Yu. A. Mostovoi, and B. A. Obinyakov. Pribory i Tekhn. Eksperim., No. 2, 39-42(Mar.-Apr. 1964). (In Russian)

Methodical errors in measuring the degree of polarization of a slow neutron beam by the method of shims are discussed. Several ways for calculating small angle scattering in shims are considered. (tr-auth)

30704 THE NUMERICAL THEORY OF NEUTRON TRANSPORT. Bengt G. Carlson (Los Alamos Scientific Lab., N. Mex.). p.1-42 of "Methods in Computational Physics. Vol. I." New York, Academic Press, 1963.

A general formulation of a numerical theory of neutron transport is presented, and a general method for numerical solution of transport problems is derived. The general formulation and method (Sn) constitute a generalization of the Wick-Chandrasekhar method. Derivation, transformation, and solution of the difference equations are covered. (D.C.W.)

30705 THE CALCULATION OF NONLINEAR RADIATION TRANSPORT BY A MONTE CARLO METHOD. Joseph A. Fleck, Jr. (Univ. of California, Livermore). p.43-65 of "Methods in Computational Physics. Vol. I." New York, Academic Press, 1963.

A method is described for calculating both time-dependent and steady-state nonlinear radiative transfer by Monte Carlo techniques. Monte Carlo and S_n calculations are compared. (D.C.W.)

Nuclear Properties and Reactions

Refer also to abstracts 30007, 30009, 30088, 30418, 30549, and 30963.

30706 (AD-428207) HANDBOOK OF PHOTONUCLEAR REACTIONS. David O. Hunt, Ari Brynjolfsson, and Raymond D. Cooper, comps. (Army Natick Labs., Natick, Mass.). Dec. 1963. 231p. (FD-1)

A compilation was made of the data that would be most useful in calculating the activities produced in food by high-energy electrons or gamma rays. The known isotopes of each element are listed with their atomic masses, half-life, and methods of decay. Photoneutron and photoproton cross sections are shown and both theoretical and experimental threshold values are listed. References are included for all data. The appendixes include a short description of the bremsstrahlung cross sections and a list of the common radioactive isotopes found in food irradiated by high-energy electrons. 105 references. (auth)

30707 (AECL-1965) A DETERMINATION OF THE RATIO OF CAPTURE-TO-FISSION CROSS SECTIONS OF U^{235}. A. Okazaki, M. Lounsbury, R. W. Durham, and I. H. Crocker (Atomic Energy of Canada Ltd., Chalk River, Ont.). Apr. 1964. 14p.

The capture-to-fission cross section ratio, α, for ^{235}U was determined for two samples of ^{235}U–Al alloy irradiated to 2.03 and 2.26×10^{21} neutrons/cm^2 in the NRU reactor. The changes in isotopic and total uranium content with irradiation were determined by chemical and mass spectrometric analysis. The value of α_0 obtained from these measurements is 0.1718 ± 0.0006, which is 2.5% lower than the weighted mean of other recent measurements. (auth)

30708 (AFOSR-J1446) FINAL REPORT [ON HIGH-ENERGY PHYSICS]. (Johns Hopkins Univ., Baltimore). Nov. 1963. 10p. (AD-427654)

Analyses of reactions of K^+ mesons with hydrogen at 2.3 Bev/c, and π^+ and π^- meson reactions with deuterium, are reported. (T.F.H.)

30709 (AFOSR-4867) HIGH-PRECISION NUCLEAR PROPERTIES STUDIES. Final Technical Report. (Uppsala Univ.). Mar. 30, 1963. 16p. (AD-414916)

Techniques and equipment are investigated for use in high precision nuclear property studies. Iron-free double focusing, iron yoke double focussing, neutron capture, electron-electron coincidence, universal coincidence, and electron-gamma coincidence spectrometers are developed. Gamma-gamma angular and differential angular correlations are analyzed. Atomic beam magnetic resonance is studied. (auth)

30710 (AFOSR-4920) STUDIES ON THE PROPERTIES AND SYSTEMATICS OF NUCLEAR STRUCTURE EFFECTS. Final Technical Report, June 1961–May 1962. Horacio E. Bosch (La Plata. Universidad Nacional). 229p. (AD-415354)

In English and Spanish.

Decay scheme studies, electron-gamma coincidences with solid state detectors, miscellaneous work on radioactivity and developments of nuclear instruments are reported. Separate abstracts were prepared for 3 of the

9 separate papers included; 6 were previously abstracted for NSA (17: 23776, 24760, 28327 32421, and 41289; 18: 7737). (R.E.U.)

For abstracts of individual items see: 29969, 30711, and 30712.

30711 (AFOSR-4920(Paper 7)) DECAY OF Sb^{126} AND Sb^{126m}. D. Horen, H. Bosch, S. Abecasis, A. Lopez Garcia, M. C. Caracoche, and E. Quel (La Plata. Universidad Nacional). 35p.

The beta and gamma radiations from ^{126}Sb and ^{126m}Sb were studied using scintillation spectrometers. Energies and relative intensities of the gammas were recorded, and the end point energy of the beta spectra was found. An energy level diagram for ^{126}Te is proposed; energies and spins are given. (R.E.U.)

30712 (AFOSR-4920(Paper 8)) CALCULATION OF CUMULATIVE YIELDS IN NUCLEAR FISSION. H. E. Bosch and S. M. Abecasis (La Plata. Universidad Nacional). 6p.

Cumulative yields for given nuclides of a radioactive chain are calculated for direct products of fissioning elements and for decay products from their precursors. (R.E.U.)

30713 (AFOSR-4999) RESEARCH ON "HIGH ENERGY PHYSICS INVESTIGATIONS USING NUCLEAR EMULSIONS." Final Report, February 1, 1961–January 31, 1963. M. A. Pomerantz and D. F. Davis (Bartol Research Foundation, Swarthmore, Penna.). Contract AF49(638)-1023. 7p. (AD-415118)

Results are presented of an experiment to measure the K meson total absorption cross section. A stack of Ilford G5 emulsion 10 × 10 centimeters and 20 cm long was exposed to a beam of 1.3 Bev/c K mesons. An effort was made to measure the variation in intensity of the K particles with distance along the beam by counting the number of their interactions. A beam of pure K particles was produced at the target. (auth)

30714 (BLG-223) INTERPRETATION DES NOYAUX DE SPIN ½ COMME ROTATEURS ASYMETRIQUES. (Interpretation of Spin-½ Nuclei as Asymmetric Rotors). J. Vervier (Centre d'Etude l'Energie Nucleaire, Brussels). Feb. 1963. 29p.

The model of Davydov for the energy levels of odd-mass nuclei with spin ½, considered as asymmetric rotors, is compared with experimental data. Good overall agreement is found for E2 and M1 electromagnetic transition probabilities and energy level positions. The model is shown to be a particular case of the more general theory of de-Shalit on the coupling between the odd nucleon and the even core. (auth)

30715 (BNL-860) THE EFFECTS OF CRYSTALLINE BINDING ON THE DOPPLER BROADENING OF A NEUTRON RESONANCE. Austin Bernabei (Brookhaven National Lab., Upton, N. Y.). Apr. 1, 1964. Contract [AT (30-2)-Gen-16]. 134p.

Thesis submitted to New York Univ., New York.

The effects of crystalline binding on the Doppler broadening of the 4.14-ev neutron resonance in tungsten metal were investigated experimentally. The shape of the resonance was measured in great detail at temperatures of 4.2, 77.8, 296, and 825°K using a neutron crystal spectrometer having good resolution. The method of "shape analysis" was used to fit the 825°K data to the Breit-Wigner one-level formula. The following resonance parameters were obtained using the effective temperature model of Lamb to account for the Doppler broadening effect: $E_0 = 4.1422 \pm 0.0005$ ev, $\Gamma_\gamma = 55.5 \pm 0.5$ Mev, and $\Gamma_n = 1.50 \pm 0.01$ Mev. The analysis, performed on a high-speed computer, employed none of the approximations that are normally used to simplify analysis. The errors quoted came from the analysis alone and do not include systematic uncertainties. In the past most resonance analysis have employed either the ideal gas model or the Lamb effective temperature model to correct for Doppler broadening. Two additional theories have been presented recently: one theory is by Nelkin and Parks and the other is by Egelstaff and Holt. Both these theories were compared with the experimental results. As the temperature of the metal target was lowered asymmetrical distortions in the shape were observed as well as shifts in the "apparent" resonant energy, E_0, to lower energies. Neither the effective temperature theory of Lamb nor the Nelkins-Parks theory predicted these shifts since they contain no parameters to account for the temperature variation of the recoil energy. The Egelstaff-Holt theory did demonstrate "apparent" E_0 shifts, but their results over-predicted these energy changes. Lamb's theory showed good but not perfect agreement with the observed resonance shape at 825°K. As the temperature was reduced the disagreement between theory and data became more pronounced. At all temperatures Lamb's effective temperature model yielded a resonance shape that was in first order agreement with the data. The expansion equation of Nelkin and Parks was slightly superior to the Lamb theory for predicting the experimental resonance shape since the first term of the expansion is equivalent to Lamb's theory. The resonance shape derived from the Nelkin-Parks theory at 825°K gave an excellent fit to the observed data. The results indicated that future resonance studies directed to determining Breit-Wigner parameters to high accuracy should use this theory to correct for the Doppler broadening. Preliminary comparisons of the data with the theory of Egelstaff and Holt were made. The calculations were carried out with computer programs LEAP AND LINESHAPE of R.C.F. McLatchie using a Debye frequency spectrum for the tungsten lattice vibrations. At temperatures of 825°K and 296°K the results of this theory are in very good agreement with the experimental data. Calculations based on this theory which employ an experimentally determined frequency spectrum have not yet been carried out but should be possible in the near future as soon as the data becomes available. In addition to the metal target, a sample in the form of a heavy water solution of sodium tungstate was also measured at room temperature. Comparison of the observed line shapes for these two different targets showed distinct differences that could not be explained by treating the solution as an ideal gas. (auth)

30716 (CEA-2298) DETERMINATION DES SECTIONS EFFICACES DE QUELQUES REACTIONS NUCLEAIRES INTERVENANT DANS LES EFFETS DU RAYONNEMENT COSMIQUE. (Determination of the Cross Sections of Some Nuclear Reactions Occurring as a Result of Cosmic Radiation). Murry Allen Tamers (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1963. 59p.

Thesis submitted to Paris. Universite.

The cross sections for the $^{16}O(p,3p)^{14}C$ reactions were measured from 47 Mev to 2.7 Bev, and the reaction mechanism was studied. The results were used to predict measurable quantities of ^{14}C in some meteorites, which were later experimentally verified. The reactions of ^{16}O, ^{14}N, and ^{12}C with ^{12}C and the mechanisms involved were also studied. The yields are shown, and excitation functions are

compared with theoretical predictions and other observations. Production of ^{22}Na in the atmosphere was considered in some detail. (D.C.W.)

30717 (COO-605-6) LOW ENERGY NUCLEAR PHYSICS. Preliminary Final Report, February 1, 1958–January 31, 1964. P. S. Jastram (Ohio State Univ. Research Foundation, Columbus). June 1964. Contract AT (11-1)-605. 7p.

Measurements are reported of the energy levels and gamma spectra of ^{26}Mg and ^{155}Gd; the lifetimes of the first rotational levels of ^{158}Dy and ^{158}Gd; and the two-gamma decay of ^{90}Zr. (T.F.H.)

30718 (JINR-P-1641) REAKTSII PEREDACHI NUKLONOV MEZHDU SLOZHNYMI YADRAMI, SOPROVOZHDAYUSHCHIESYA OBRAZOVANIEM SOSTAVNOI SISTEMY. (Nucleon Transfer Reaction Accompanied by the Formation of a Compound System of Complex Nuclei). E. Lozhinski (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Reactions). 1964. 20p.

An experimental study of the dependence of the angular distributions for the (p + n) pickup and (p + 3n) stripping reactions upon the energy of ^{22}Ne ions was made. The measurements were performed for angles of 0 to 180°, and for energies of 90 to 140 Mev (laboratory system). A catcher-foil method was used with ^{197}Au as the target. The results obtained for the reaction $^{197}Au(^{22}Ne, +d)^{24}Na$ point to the tunneling mechanism of the deuteron transfer into the incident nucleus. The contribution of the grazing process of the (p + n) transfer turns out to be much smaller. The behavior of the total cross section for the generation of ^{24}Na of energies near the Coulomb barrier turned out to be close to the excitation function of single neutron transfers, in agreement with that which may be expected in the case of transfer of an associated (p + n) group. The dependence upon the energy of the angular distribution of final products in the reaction $^{197}Au(^{22}Ne, -p-3n)^{18}F$ shows that in the stripping of (p + 3n) from the ^{22}Ne nucleus, the prevalent reaction mechanism is the transfer of nucleons in grazing collisions of nuclei. In this case the degree of association of the transfer process seems to be low. In the range of angles 90 to 180°, for the differential cross section of the angular distribution of the (p + 3n) stripping and (p + n) pick-up reactions, several maxima were observed, the number and position of which changes with the incident particle energy. It is proposed that the observed effects are connected with formation of a very short-lived compound system (a partial fusion system) of the interacting nuclei. On the basis of an analysis made of the measured angular distributions a conclusion was drawn that the partial fusion system of complex nuclei (in the investigated case) has mainly an angular momentum of about 15 h. (auth)

30719 (JINR-P-1642) OBRAZOVANIE Li^8 V RASSHCHEPLENIYAKH YADER C^{12} PROTONAMI VYSOKOI ENERGII. (Li^8 Production in Disintegrations of C^{12} Nuclei by High-Energy Protons). R. V. Afanasieva, O. V. Lozhkin, V. M. Maltsev, and P. Yu. Jakovlev (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 9p.

A fragmentation model is treated under the hypothesis of inelastic reactions between the primary proton and cluster in the nucleus (the example of ^8Li production by high-energy protons in ^{12}C disintegrations). This model is shown to describe the well-known experimental data without a special choice of the parameters. (auth)

30720 (JINR-P-1651) SPONTANNO DELYASHCHIESYA PRODUKTY V YADERNYKH REAKTSIYAKH $U^{238} + Ne^{20}$ I $U^{238} + O^{16}$. (Spontaneously Fissionable Products in Nuclear Reactions $U^{238} + Ne^{20}$ and $U^{238} + O^{16}$). V. A. Druin, N. K. Skobelev, B. V. Fefilov, V. I. Kuznetsov, Yu. V. Lobanov, and Yu. Ts. Oganesyan (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Reactions). 1964. 10p.

In the bombardment of ^{238}U with ^{20}Ne and ^{16}O ions accelerated in a 310-cm cyclotron, there was found a spontaneously fissionable product with $Z \leq 100$ and half life of 3.5 sec. (auth)

30721 (JINR-P-1663) RADIATSIONNII ZAKHVAT OSTANOVIVSHIKHSYA π^--MEZONOV YADRAMI. (Radiative Capture of Stopped π^- Mesons by Nuclei). V. I. Petrukhin and Yu. D. Prokoshkin (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1964. 7p.

The search experiments described were undertaken to detect a small-intensity radiative capture of π^- mesons by complex nuclei. The probability of the process is 2×10^{-2}; it does not depend significantly on the nucleus charge. The energy spectrum of γ-quanta measured with the help of the Cherenkov spectrometer turned out to be "hard," its average energy being about 80 Mev. (auth)

30722 (JINR-P-1665) UPRUGOE RASSEYANIE $d\mu$-MEZOATOMOV NA PROTONAKH, DEITRONAKH I SLOZHNYKH YADRAKH. (Elastic Scattering of $d\mu$ Mesonic Atoms on Protons, Deuterons and Complex Nuclei). V. P. Dzhelepov, P. F. Ermolov, V. I. Moskalev, V. V. Filchenkov, and M. Friml (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1964. 29p.

Experiments for the study of the kinetics of mesic atom processes are described. The use of a diffusion chamber in a magnetic field allowed measurement of the range distribution of mu-mesic deuterium atoms for different concentrations of deuterium and Z- admixtures (carbon, oxygen) in hydrogen, and to determine the elastic scattering cross sections for $d\mu$–atoms. The cross sections were obtained, with the aid of χ^2-analysis, by comparing the experimental distributions with those calculated by the Monte Carlo method. The values are in agreement with theory. The lifetime of a $d\mu$-atom in gaseous hydrogen was determined to be 1.25 ± 0.16 and 0.38 ± 0.05 msec, for the C and O atom concentrations of 1/4000 and 1/800, respectively. (auth)

30723 (LA-2811(Add.II)) RE-EVALUATION OF OPTIMAL PARAMETERS FOR POST-FISSION BETA DECAY. James J. Griffin (Los Alamos Scientific Lab., N. Mex.). Apr. 1, 1964. Contract W-7405-eng-36. 30p.

A calculational error in a previous calculation (LA-2811 and LA-2811 Add. I) is corrected. The two adjustable parameters in the description are re-evaluated to optimize the fit with the corrected version of the theory. Previous qualitative conclusions about the encouraging consistency between the model and the available data remain valid. Quantitative modifications occur in certain extrapolations of the calculation reported earlier. The corrected extrapolations, which supersede earlier results, are presented. (auth)

30724 (NIJS-R-420) COMPARISON OF SPECTRA FROM $Al^{27}(n,\gamma)^{28}Al$ AND $Al^{27}(d,p)Al^{28}$. F. Cvelbar, A. Hudoklin, M. Najzer, and V. Ramsak (Nuklearni Institut "Josef Stefan," Ljubijana, Yugoslavia). Oct. 1963. 6p.

The gamma spectrum from the radiative capture of 14-Mev neutrons in ^{27}Al was measured and compared with previous data for the $^{27}Al(d,p)^{28}Al$ reaction. The paper was presented at the Yugoslav-Polish Symposium in Krakow, May 1963. (R.E.U.)

30725 (NP-13976) RELACION ENTRE LAS SECCIONES EFICACES PARA EL PAR ISOMERICO Cs^{134m}, Cs^{134} FORMADO EN LA REACCION NUCLEAR $Cs^{133}(d,p)Cs^{134}$. Informe No. 99. (The Relation Between the Effective Cross Section of the Isomer Cs^{134m}, Cs^{134} Formed in the Reaction $Cs^{133}(d,p)Cs^{134}$. Report No. 99). S. J. Nassiff, A. Mocoroa, and H. Vignau (Argentina. Comisión Nacional de Energia Atómica, Buenos Aires and La Plata. Universidad Nacional. Istituto de Fisíca). 1963. 9p.

The relations between the cross sections σ_m/σ_g for the isomers ^{134m}Cs and ^{134}Cs produced in the (d,p) reaction were determined experimentally as a function of the deuteron energy. The results obtained are discussed. (tr-auth)

30726 (NP-14024) POLYARIZATSIYA NEITRONOV V REAKTSII $B^{11}(d,n)C^{12}$, C^{12*}. (Neutron Polarization in the Reaction $B^{11}(d,n)C^{12}$, C^{12}). V. A. Smotraev and I. S. Trostin (Akademiya Nauk S.S.S.R. Institut Teoreticheskoi i Eksperimental'noi Fiziki, Moscow and U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). 1963. 27p.

The polarization of neutrons from the reaction $^{11}B(d,n)^{12}C$ for the ground and the first excited states of ^{12}C was measured. The average deuteron energy was 9.3 ± 1.2 Mev and angles were 20 to 150° (l.s.). (auth)

30727 (NP-14053) $(p,p'\gamma)$-WINKELKORRELATIONEN BEI 5.8 Mev AN $Zn^{64,66,68}$ (these). ($(p,p'\gamma)$-Angular Correlations at 5.8 Mev in $Zn^{64,66,68}$ (thesis)). Roland Szostak (Zurich. Eidgenössische Technische Hochschule). 1963. 32p.

At proton energy of 5.8 Mev, angular correlations were measured between inelastically scattered protons and subsequently emitted γ rays from the first excited states in ^{64}Zn, ^{66}Zn, and ^{68}Zn for azimuthal angles $\Phi = 0$ and π and at proton angles 45, 90, and 135° as function of the γ angle between 0 and 156°. The isotopes ^{64}Zn and ^{66}Zn show very similar behavior; from comparison of the experimental data with predictions of statistical theory it is concluded that the reaction proceeds mostly by way of compound nucleus formation with a small admixture of direct interaction at forward scattering angles. For ^{68}Zn, however, the direct reaction predominates and cross sections in this case are one order of magnitude smaller than those for ^{64}Zn and ^{66}Zn. This different behavior for ^{68}Zn might possibly arise from the low (p,n) threshold. The neutron exit channel thereby represents a competing decay mode to the inelastic proton scattering. 77 references. (auth)

30728 (NP-14055) THE OPTICAL MODEL OF THE NUCLEUS. An Indexed and Abstracted Literature Review. L. Wallin, A. Persson, M. Leimdoerfer, B. Johansson, and R. Akselsson (Sweden. Försvarets Forskningsanstalt, Stockholm). Apr. 1964. 108p.

All available literature, dealing with optical model calculations, was reviewed to aid in assessing suitable well parameters and to indicate when the model is successful in predicting various nuclear data. The material investigated was indexed according to nuclide, and short abstracts were prepared to provide a concise summary of the contents and main results. 342 references were examined. (auth)

30729 (NP-14056) SOME REMARKS ON THE APPLICATION OF THE OPTICAL MODEL TO LIGHT NUCLEI. B. Johansson and L. Wallin (Sweden. Forsvarets Forskningsanstalt, Stockholm). May 1964. 27p.

Difficulties in fitting the optical model to experimental data, especially in the region of light nuclei, are pointed out. Improved results for ^{14}N and ^{16}O are given. (auth)

30730 (NP-14096(p.7-15)) PHOTODISINTEGRATION OF OXYGEN AND NITROGEN YIELDING ALPHA PARTICLES. M. Elaine Toms (Naval Research Lab., Washington, D. C.).

Cross section measurements are presented for $^{14}N(\gamma,\alpha)^{10}B$ for photon energies of 16 to 21 Mev, and $^{16}O(\gamma,\alpha)^{12}C$ and $^{16}O(\gamma,4\alpha)$ for 11- to 21-Mev photons. Reaction mechanisms are discussed. (R.E.U.)

30731 (NYO-1807-13) THE INTERACTION OF NUCLEI WITH ELECTROMAGNETIC MULTIPOLES. G. Breit and M. L. Rustgi (Yale Univ., New Haven). [1967]. Contract AT(30-1)-1807. 7p. (CONF-550-2)

From The International Conference on High-Energy Physics, Dubna, Aug. 1964.

In connection with the photodisintegration of the deuteron and similar problems, the parts of the interaction energy that are mainly independent of questions concerned with mesonic exchange currents are separated from those affected by the exchange character of nuclear forces. The direct introduction of the intensity of magnetization $\vec{M}$ is shown to be unnecessary, the current density associated with nucleonic magnetic moments accounting for effects often represented by the formal introduction of $\vec{M}$. Transformations of field strengths leading to an equivalent formulation using $\vec{M}$ are devised. The considerations are in terms of the irreducible tensor classification of the multipoles. No explicit use of gauge invariance has to be made. The entrance of limitations caused by electromagnetic form factors is located. The simplifications caused by employing the nonretarded approximation were studied, although the treatment in its general form does not employ this approximation. (auth)

30732 (NYO-2545-1) A STUDY OF PROTON-INDUCED SPALLATION REACTIONS OF NEODYMIUM-150. Final Report. Clarence G. Heininger, Jr. (Saint John Fisher Coll., Rochester, N. Y.). 1964. Contract AT(30-1)-2545. 8p.

Cross sections for production of ^{143}Ce and ^{143}Pr by the proton bombardment of ^{150}Nd at proton energies of 160 to 240 Mev are measured. The ratio of these cross sections is compared with the calculated ratio. (T.F.H.)

30733 (NYO-9891) WAVE FUNCTIONS IN THE $1f_{\frac{7}{2}}$ SHELL. J. D. McCullen, B. F. Bayman, and Larry Zamick (Princeton Univ., N. J. Palmer Physical Lab.). June 1964. Contract AT(30-1)-937. 68p.

Eigenvalues and eigenvectors of matrices of a two-particle interaction, calculated with respect to states of several neutrons and protons in the $f_{\frac{7}{2}}$ shell, are tabulated. The interaction is characterized by eight numbers giving the interaction energies in the eight levels available to two $f_{\frac{7}{2}}$ particles. Calculational methods and computer-printout results are given for $^{43,44,45,46,47}Sc$ and $^{43,44,45,46,47,48,49}Ti$. (R.E.U.)

30734 (SAR-G-63-38) SPECTRES GAMMA DE RADIOÉLÉMENTS FORMES PAR IRRADIATION SOUS NEUTRONS DE 14 Mev. (Gamma Spectra of Radioelements Formed by Irradiation with 14-Mev Neutrons). G. Aude and J. Laverlochere (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Grenoble). 1963. 106p.

The gamma spectra of the radioisotopes formed in the exposure of fifty elements to 14-Mev neutrons were measured, and sensitivities (in μg) of radioisotope determinations were evaluated. The spectra and sensitivities are compiled. (D.C.W.)

30735 (TID-20657) GAMMA RAYS FROM INELASTIC NEUTRON SCATTERING AND NEUTRON CAPTURE. Progress Report, December 15, 1961–August 15, 1962. D. O. Nellis, R. W. Benjamin, J. D. Henderson, R. L. Prewett, J. B. Ashe, I. L. Morgan, and J. T. Prud'homme (Texas Nuclear Corp., Austin, Tex.). Contract AT(40-1)-2791. 83p.

Gamma-ray production cross sections, gamma-ray angular distributions, and capture gamma ray spectral shapes are measured for several nuclei with an anti-coincidence gamma spectrometer. (T.F.H.)

30736 (TID-20658) NUCLEAR PHYSICS DIVISION. Annual Progress Report for Period Ending September 1, 1963. Ira L. Morgan, J. B. Ashe, R. W. Benjamin, O. M. Hudson, S. C. Mathur, D. O. Nellis, C. V. Parker, and W. E. Tucker (Texas Nuclear Corp., Austin, Tex.). Sept. 15, 1963. Contract AT(40-1)-2791. 176p.

Gamma Ray Production Cross Sections. Gamma ray production cross sections (n,n'γ) were measured using time-of-flight techniques in conjunction with a total absorption gamma ray spectrometer of the anticoincidence type. Several hundred gamma ray production cross sections were measured for suitable elements between Z = 3 to Z = 92 at selected neutron energies. Specifically data were obtained extensively at E_n = 1.0, 4.0, and 14.8 Mev. Data were obtained at E_n = 1.0, 1.5, 2.5, 3.0, 3.5, 4.0, 4.5, and 14.8 Mev for selected isotopes or elements. Gamma Ray Angular Distributions. The angular distribution of the gamma rays produced due to neutron inelastic scattering was observed using time-of-flight techniques and a total absorption gamma ray spectrometer of the anti-coincidence type. Large anisotropies are observed near threshold. $\sigma(\theta)_{30°}/\sigma(\theta)_{90°}$ was observed to vary from 2.0 to 1.15 in some nuclei. Specific angular distributions were obtained for Mg, Al, Si, ^{56}Fe, ^{206}Pb, ^{207}Pb, ^{208}Pb, and ^{209}Bi. The angular distributions are being compared with theory. ^{3}He(n,n)^{3}He and ^{3}He(n,p)T Cross Section Measurements. The virtual state in ^{4}He is ~1.0-Mev broad and possibly effects the 1/v dependence of the ^{3}He(n,p)T cross section as well as the angular distribution of the kev neutrons elastically scattered from ^{3}He. Pulsed neutron techniques as well as ^{3}He neutron spectrometers are being used to measure the cross section. A Study of the ^{40}Ar(n,p)^{40}K and ^{40}Ar(n,α)^{37}Cl Reactions. The principal result to date is the construction of a high pressure argon gas scintillator for use in the cross section measurements as a function of neutron energy. (auth)

30737 (UCRL-7478-T) ON THE CONNECTION BETWEEN THE DISTORTED WAVE AND DISPERSION THEORIES OF DIRECT NUCLEAR REACTIONS. Arnold Tubis (California. Univ., Livermore. Lawrence Radiation Lab.). Aug. 21, 1963. Contract W-7405-eng-48. 12p.

It is shown that the distorted-wave and dispersion methods are not as dissimilar as has been suggested. Stripping (d,p) reactions are considered. (R.E.U.)

30738 (UJV-1017/64) γ-SPECTRUM OF NEUTRON-DEFICIENT La ISOTOPES OF T 1/2 ~ 5 HOURS. J. Frána, I. Řezanka, M. Vobecký, and A. Maštalka (Československá Akademie Věd. Ústav Jaderného Výzkumu, Řež). [1964]. 5p.

The gamma spectra of ^{132}La and ^{133}La were studied using a NaI crystal and a 200-channel pulse-height analyzer. (R.E.U.)

30739 (UJV-1018/64) DECAY OF Cs^{134m}. J. Frána, I. Řezanka, and A. Špalek (Československá Akademie Ved. Ustav Jaderného Výzkumu, Řež). [1964]. 10p.

The decay of the isomeric state of ^{134}Cs was studied. The half life (2.93 ± 0.05 hours) was determined. From measurements carried out by means of a spectrometer with short lens, scintillation measurements, and chemical separations, the nonexistence of the weak decay β_- of this state was proved, contrary to statements found previously in literature (maximum possible intensity 0.02%, against the value of 1% found in literature). The spectrum of conversion electrons was measured by a double-focusing spectrometer, and the following transition energies were determined: 127.3 ± 0.3 kev (E3) and 138.4 ± 0.4 kev (M4) (K : L : M + N is 92 : 100 : 27 for the 127.3-kev transition, and 206 : 100 : 31 for the 138.4-kev transition). The K conversion coefficient of the 127-kev transition was measured, resulting in a value of 2.55 ± 0.4. The ratio of transition intensities is $I_{138} : I_{127}$ = 5.7 : 1000. (auth)

30740 (UCRL-Trans-1079) CONCERNING SURFACE REACTIONS OF NUCLEAR STRIPPING. V. M. Strutinskii (Akademiya Nauk S.S.S.R. Ordena Lenina Institut Atomnoi Energii). Translated for Univ. of California, Lawrence Radiation Lab., Berkeley. 1963. 20p.

A simple expression was obtained for the differential, transverse, reaction section of nucleon transfer; it is based on the model of marginal impacts (collisions). Depending on the degree of "classicality" of the process, various angular distributions are obtained. Existing experimental data concerning the reactions of transfer, with heavy ions, are in satisfactory agreement with the model of marginal impacts. An application of the formulas obtained to other surface reactions is possible. (auth)

30741 (UCRL-Trans-1081) CALCULATIONS OF THE INFLUENCE OF PAIRING CORRELATIONS IN THE E1 TRANSITIONS OF ODD-A NUCLEI IN THE RARE EARTH REGION. G. Monsonego and R. Piepenbring (Strasbourg. Université. Centre de Recherches Nucléaires). Translated for Univ. of California, Lawrence Radiation Lab., Berkeley. Jan. 1964. 16p.

An attempt is made to study the influence of pairing correlations in the E1 transitions of odd A nuclei in the rare-earth region. Reduction factors introduced by pairing correlations are computed with usual Bardeen-Cooper-Schrieffer wave functions and also with "projected" wave functions that are eigenfunctions of number operator. Different effective charges for neutrons and protons are introduced. The results obtained by use of the single-particle spectra of Nilsson and Prior are nearly the same that those obtained by using of Soloviev's spectrum. Reduction factors are found to account for only a part of the E1 transitions that are experimentally observed. (auth)

30742 $\langle p^n|p^{n-3},p^3\rangle$ FRACTIONAL PARENTAGE COEFFICIENTS. D. Chlebowska (Inst. for Nuclear Research, Warsaw). Acta Phys. Polon., 25: 513-26(Apr. 1964).

A method of calculation of three-nucleon fractional parentage coefficients from one- and two-nucleon coefficients is given. The numerical values of the coefficients are estimated for p^n nuclei on the basis of the shell model with LS coupling. (auth)

30743 NUCLEAR ELECTRIC QUADRUPOLE MOMENT OF RADIOACTIVE NUCLIDE $^{152}_{63}$Eu OBTAINED BY THE ISOTOPE SHIFT EFFECT IN THE ATOMIC SPECTRUM. L. Gabla (Jagellonian Univ., Krakow). Acta Phys. Polon., 25: 617-25(Apr. 1964).

Isotope shift effect measurements on the Eu I line λ = 5765.2 Å of the isotope ^{152}Eu (half life 12.5 y) are described. The result obtained is $\delta\nu(^{151}\text{Eu}-^{152}\text{Eu}) = (64.5 \pm 3.6) \times 10^{-3}$ cm^{-1}. The nuclear electric quadrupole moment of this nuclide was calculated using the nonperturbation Broch-Bodmer theory of the isotope shift effect. The value

obtained is $(2.4 \pm 0.3) \times 10^{-24}$ cm^2. Hence, the intrinsic electric quadrupole moment of ^{152}Eu is $(5.75 \pm 0.76) \times 10^{-24}$ cm^2. (auth)

30744 ALPHA FINE STRUCTURE IN Bi-213. G. Graeffe, K. Valli, and J. Aaltonen (Univ. of Helsinki). Ann. Acad. Sci. Fennicae, Ser. A VI, 145: 1-10(1964).

The decay of ^{213}Bi, separated from ^{229}Th, was investigated by using ionization chambers, semiconductor detectors and an alpha-gamma coincidence spectrometer. In (2.0 ± 0.1) per cent of the ^{213}Bi decays, alpha particles of (5.869 ± 0.010) Mev were emitted, and in (0.16 ± 0.03) per cent of the decays, (5.549 ± 0.010) Mev alphas were emitted. This leads to a new level at (325 ± 10) kev in ^{209}Tl. The lower energy alphas were found to be in coincidence with a 325 kev gamma. (auth)

30745 IN-TIME INTEGRATED THERMAL NEUTRON FLUXES BY MEASUREMENT OF CHEMICALS FORMED. C. Hyver. Bull. Inform. Sci. Tech. (Paris), No. 81, 31-3 (Mar. 1964). (In French)

The possibility of using transmutation phenomenon for measuring in-time integrated fluxes, when the activation method cannot be applied, was considered. A method for determining the atoms produced using x-ray fluorescence is presented. (auth)

30746 IN-TIME INTEGRATED FISSION RATE STUDIES IN URANIUM USING ALPHA OR GAMMA SPECTROMETRY. A. Guillon, S. May, S. Sapena, and R. Sauvagnac. Bull. Inform. Sci. Tech. (Paris), No. 81, 35-7 (Mar. 1964). (In French)

Some methods for measuring burnup of fissile material are reviewed. Alpha spectrometry after irradiation (measurement of ^{235}U disappearing), which is accurate only for high integrated fluxes, is discussed. Measurements of the ratio of fission products to uranium are also considered. Some examples are given for irradiations made under different conditions. The fission products studied were ^{137}Cs, ^{144}Ce, and ^{140}Ba. A chemical separation is described for each of these radionuclides. (auth)

30747 SPECTRAL ANALYSIS OF INTERMEDIATE AND FAST NEUTRONS BY MEANS OF NUCLEAR EMULSIONS. C. Beets (CEN, Mol. Belg.) and S. Passe. Bull. Inform. Sci. Tech. (Paris), No. 81, 49-55(Mar. 1964). (In French)

After a survey of the properties of nuclear emulsions, a description is given of the methods used for spectrometry by using these emulsions. Ultra-fine grain emulsions, emulsion disc detectors, and scanning by means of microphotography or a semiautomatic microscope are discussed. The (n,p) and ^{6}Li(n,t)^{4}He interactions were then analyzed. The low energy limits for which this technique is valid are 150 and 70 kev, respectively. This technique was especially adapted for spectral analysis above 300 kev by observation of the recoil protons. (auth)

30748 THE USE OF Rh^{103} [AS THRESHOLD DETECTORS]. J. Brisbois, J.-L. Campan, P. Ko, and A. Leridon. Bull. Inform. Sci. Tech. (Paris), No. 81, 85-92(Mar. 1964). (In French)

The possibility of evaluating absolute activation using ^{103}Rh as threshold detector is reported. The nuclear reaction is: ^{103}Rh(n,n')^{103m}Rh (half life of ^{103m}Rh: 57 min). X rays at 20 kev were defected by a scintillation counter, and the absolute efficiency, taking into account self-absorption and absorption in the windows, was evaluated. The accuracy attained was about 3%. (auth)

30749 THE USE OF THORIUM FOR TIME-INTEGRATION OF FAST NEUTRON FLUX. MEASUREMENT BY γ SPECTROMETRY OR BY CHEMICAL ANALYSIS OF A FISSION PRODUCT. J. Comera and S. May. Bull. Inform. Sci. Tech. (Paris), No. 81, 107-10(Mar. 1964). (In French)

The usual methods used for the dosimetry of fast neutrons are unavailable for long irradiation times since either the half life is too short or the threshold too high. The use of thorium dosimetry for long irradiation periods making use of the fact that fission is produced by neutrons with energies of not less than 1.2 Mev is described. The method of measurement adopted was the quantitative determination of a fission product with a high fission yield, ^{137}Cs. After irradiation, ^{137}Cs is precipitated in the presence of an inactive carrier as cesium phosphotungstate. The absolute activity of the ^{137}Cs is deduced by comparison, thus making it possible to calculate the value of the fast neutron flux. (auth)

30750 UTILIZATION OF COPPER, NICKEL, TITANIUM, AND IRON AS INTEGRATORS OF FAST NEUTRON FLUXES. J. Brisbois, J. Comera, and G. Pleyber. Bull. Inform. Sci. Tech. (Paris), No. 81, 111-16(Mar. 1964). (In French)

For the measurement of fast neutron fluxes the following threshold reactions: ^{63}Cu (n,α) ^{60}Co, ^{58}Ni (n, p) ^{58}Co, ^{46}Ti (n, p) ^{46}Sc, and ^{54}Fe (n, p) ^{54}Mn are widely used. The properties of these reactions are reviewed and the conditions in which they may be usefully employed are discussed. (auth)

30751 CHARACTERISTICS OF NUCLEAR EVAPORATION. Eric Jeannet (Universite, Neuchatel, Switzerland). Bull. Soc. Neuchatel. Sci. Nat., 86: 61p.(1963). (In French)

Evaporation stars produced by bombarding thin sheets of Cu, Ag, and Pt with high energy neutrons ($E \simeq 400$ Mev) were observed in nuclear emulsions (sandwich). The black tracks separated in two groups according to their electric charge ($z = 1$ and $z \geq 2$) were systematically studied. The observed energy spectra have been compared with a theoretical expression taking into account the cooling of the nucleus during the successive steps of evaporation. In this expression, the mean temperature is related to the initial and final temperatures (T_i and T_f, respectively) through the relation $T = \sqrt{T_i T_f}$. In contrast to the energy distributions, the range distributions dN/dR show peaks due to the emission of protons, deuterons, and tritons for $z = 1$, and of ^{6}Li, ^{4}He, and ^{3}He for $z \geq 2$. The apparent lowering of the Coulomb barrier for charged particles is discussed on the basis of a diffuse nuclear potential. These range distributions allow the evaluation of the emission ratio for the different kinds of particles. The angular distributions of the tracks interpreted in terms of an intranuclear-cascade and a subsequent evaporation process, give the number of protons ($E < 30$ Mev) and alpha knock-ons per star. The resulting numbers, i.e., 0.3 and 0.6 respectively, are independent of A. Size and excitation energy distributions of the stars are discussed and compared with theoretical results obtained by Monte-Carlo calculations. (auth)

30752 A GENERAL DISCUSSION ON HIGH RESOLUTION NUCLEAR MAGNETIC RESONANCE, 17TH-19TH SEPTEMBER 1962. Discussions Faraday Soc., No. 34, 1-201(1962).

Twenty-four papers are included on the observation, applications, and theory of NMR in diamagnetic and paramagnetic materials and on applications to the determination of molecular structure and the study of kinetic processes. Separate abstracts were prepared for eight papers. (D.C.W.)

For abstracts of individual papers see: 29614, 29615, 29616, 29676, 29677, 29678, 29679, and 30753.

30753 POSSIBILITIES FOR HIGH-RESOLUTION NUCLEAR MAGNETIC RESONANCE SPECTRA OF CRYSTALS. E. R. Andrew and R. G. Eades (University Coll. of North Wales, Bangor, Wales). Discussions Faraday Soc., No. 34, 38-42(1962).

The observation of high-resolution nmr spectra in liquids is possible because rapid molecular tumbling removes the dipolar broadening which in solids obscures the fine structure. It is shown that rapid rotation of solid specimens about an axis inclined at an angle 54° 44′ to the direction of the applied magnetic field can achieve the same end. Some experimental results are reviewed, and factors affecting the residual line-width are discussed. For proton and fluorine resonances it may prove difficult to achieve speeds of macroscopic rotation which are high enough to be useful. The alternative approach of a fixed specimen placed in a rotating magnetic field is, therefore, discussed; and the construction of a practical system is outlined. Nuclear cross-relaxation induced by specimen rotation in solid phosphorus pentachloride is also discussed. (auth)

30754 RESEARCH ON THE INFINITELY SMALL. R. Anthoine (CERN, Geneva). Energie Nucl., 6: No. 2, 74-80(Mar.-Apr. 1964). (In French)

For research on the infinitely small, CERN offers a favorable environment and working facilities. The purpose of CERN, the reasons for its creation and installation at Geneva, and the nuclear physics studies carried out there are described. The synchrocyclotron and synchrotron accelerate protons to the energy necessary to "penetrate" the nuclei of the bombarded targets, thus producing new particles. The short life of these particles is revealed in nuclear detectors. The interpretation of the data obtained represents considerable work. (auth)

30755 THE ELECTRON ENERGY SPECTRUM FROM I^{131}. C. F. Barnaby (University Coll. Hospital, London). Health Phys., 10: 437-8(June 1964).

The momentum spectrum for ^{131}I was used to calculate the electron energy spectrum. (C.H.)

30756 GAMMA TRANSITIONS IN O^{18}. A. Gobbi, A. Ruh, B. Gobbi, and R. E. Pixley (Eidgenossische Technische Hochschule, Zurich). Helv. Phys. Acta, 37: 104-12 (1964).

The gamma de-excitation of the 3.92- and 4.45-Mev states in ^{18}O was studied using particle-gamma coincidence methods. The states were produced by inelastic scattering of 5.8 Mev protons. The 3.92-Mev state decayed to the 1.98-Mev state and ground state with intensities of 85 and 15, respectively. The 4.45-Mev state de-excited via cascades through the 3.63- and 1.98-Mev states with intensities of 63 and 37, respectively. No 4.45-Mev ground-state transition was found. The significance of these results is discussed. (auth)

30757 OCTUPOLE VIBRATIONS IN SPHERICAL NUCLEI. R. J. Lombard (Laboratoire de Physique des Hautes Energies, EPF, Zurich). Helv. Phys. Acta, 37: 160-4 (1964).

A systematical study of the 3^- state in even-even nuclei $40 \leq A \leq 150$ is presented. The liquid drop model was applied to show the behavior of $\hbar\omega_3$ against A. For the nuclei $Z = 50$ and $N = 82$ $\hbar\omega_3$ was calculated using the pairing correlation model. (auth)

30758 OBSERVATION OF Be^8-DIRECT PRODUCTION. G. C. Deka and A. K. Goswami (Cotton Coll., Gauhati, India). Indian J. Phys., 37: 645-50(Dec. 1963).

Pairs of alpha particles are observed and analyzed as due to the decays of a ^8Be nucleus. The kinetic energy of ^8Be at production and the Q value of the reaction ^8Be-2α are calculated. The energy distribution indicates that the ^8Be nuclei were possibly produced during the evaporation of the nucleus. The Q value so obtained has also fair agreement with the expected Q value. (auth)

30759 FLUCTUATIONS IN MULTIPLE CAPTURE PROCESSES. Albert G. Petschek (Los Alamos Scientific Lab., N. Mex.). J. Math. Phys. (N. Y.), 5: 998-9(July 1964). (LADC-6049)

The fluctuation in the number of many-fold captures by an element exposed to a high neutron flux is computed. It is found that the fluctuations are identical to those that would be obtained by selecting nuclei at random from an infinite supply with the appropriate average composition. (auth)

30760 A STUDY OF THE DECAY SCHEME OF Eu^{146}. Eiko Takekoshi (Japan Atomic Energy Research Inst., Tokyo), Zyun-Itirō Matsumoto, Mitsuhiko Ishii, Kazusuke Sugiyama, Shogo Hayashibe, Hiroshi Sekiguchi, and Haruo Natsume. J. Phys. Soc. Japan, 19: 587-605(May 1964).

The level scheme of ^{146}Sm from the decay of 4.59 ± 0.03-day ^{146}Eu was investigated with beta and scintillation spectrometers, gamma and K-conversion electron coincidences, and directional correlation measurements. Several previously unreported transitions were observed, and ten other levels were postulated on the basis of energy, intensity, and coincidence considerations. The experimental results are presented and discussed, together with the ^{146}Eu decay scheme. (D.C.W.)

30761 DECAY OF Zr^{86} AND GAMMA-RAYS OF Zr^{87} AND Zr^{89}. Yohko Awaya and Yoshihiko Tendow (Inst. of Physical and Chemical Research, Tokyo). J. Phys. Soc. Japan, 19: 606-13(May 1964).

The decay of ^{86}Zr was studied with scintillation techniques and a magnetic beta spectrometer. Besides the previously reported 247 ± 2-kev gamma ray, 615 ± 5- and 32 ± 3-kev gamma rays were observed. The relative intensities of the 32, 247 and 615 kev gamma rays are ~25, 100 and 7 ± 2, respectively. The K/(L + M) ratio and K conversion coefficient of the 247-kev transition are 6.1 ± 0.3 and 1.4 ± 1.5 × 10^{-2}, respectively. The half life of ^{86}Zr was determined to be 16.5 ± 0.1 hr. The decay scheme of ^{86}Zr is discussed on the basis of these results. A new 2.2 ± 0.1-Mev gamma ray of ^{87}Zr was found; and the 1.2 ± 0.05- and 1.7 ± 0.1-Mev gamma rays of ^{87}Zr and ^{89}Zr, respectively, were confirmed. (auth)

30762 HYPERFINE STRUCTURE OF THE RHENIUM GROUND STATE AND NUCLEAR MAGNETIC MOMENTS OF ^{186}Re AND ^{188}Re. R. Winkler (Technische Universität, Berlin). Naturwissenschaften, 51: 236-7(1964). (In German)

The $(5d^5)\ 6s^2a^6S_{5/2}$ ground state of rhenium was analyzed to determine its hyperfine structure. Nuclear magnetic moments of ^{186}Re and ^{188}Re were determined for use in the analysis. (M.C.G.)

30763 FORMATION OF ^{13}N AND ^{18}F BY RECOIL PROTON FLUX IN WATER MODERATED REACTOR. Takashi Tagami (Hitachi, Ltd., Tokyo), Masaaki Yamamoto, and Yasuo Osawa. Nippon Genshiryoku Gakkaishi, 6: 260-9 (May 1964). (In Japanese)

It is shown that the energy spectrum or recoil proton flux $\phi_p(E)$, produced as a result of neutron collisions with hydrogen atoms in moderating water, is related to the fast neutron flux $\phi_n(E)$ as follows: $\phi_p(E) \approx (2 \times 10^{-3}/E)\phi_n(E)$, E(Mev) > 2 Mev. Using this relation, analytical methods

for the production rates of ^{13}N and ^{18}F from the reactions, $^{16}O(p,\alpha)^{13}N$ and $^{18}O(p,n)^{18}F$, in a water-moderated reactor are proposed. The theoretical results were compared with experiments involving activation analysis of the coolant in HTR as well as chemical procedures to identify the types of reactions. Agreement between theory and experiments was satisfactory. (auth)

30764 AN ELECTROSTATIC METHOD FOR THE RECOIL MEASUREMENT OF SUB-NANOSECOND NUCLEAR LIFETIMES. T. Novakov, J. M. Hollander, and R. L. Graham (Univ. of California, Berkeley). Nucl. Instr. Methods, 26: 189-200(Mar. 1964). (UCRL-10875)

The use of a high resolution beta-ray spectrometer ($\Delta p/p \sim 0.1\%$) to measure short lifetimes in nuclei recoiling from nuclear reactions or alpha decay is described. The method takes advantage of the Doppler shift in the momentum given to electrons emerging from recoiling atoms which is ≥0.1% following alpha decay and ≥1% for typical heavy ion reactions. The 42.8-kev transition in ^{240}Pu following alpha decay of ^{244}Cm was studied in detail as an illustrative example; the L_{II} and L_{III} conversion lines from an uncovered ^{244}Cm source are shown to have the expected Doppler structure in the form of high momentum shoulders extending ~0.3% above the unshifted momentum p_0 of electrons emerging from atoms at rest in the source backing. With use of an electrode system of two grids placed close to the source so that the electrons are first decelerated and then reaccelerated it is shown that the electrons emitted from recoiling atoms can be given a net acceleration which is proportional to the distance traveled by the atom from the source surface before electron emission takes place. The L_{III} 42.8 line was studied directly and also in coincidence with alpha particles detected behind the source, with applied electric fields of up to 40,000 volt/cm. Analysis of the resulting line shapes yields a half life of $(1.6 \pm 0.2) \times 10^{-10}$ sec, without correction for absorption in the source (which would tend to raise the value). A value of $(1.72 \pm 0.15) \times 10^{-10}$ sec was measured electronically by Bell et al. A discussion of the potentialities of the method shows that it should be possible to measure lifetimes as short as $\sim 3 \times 10^{-12}$ sec following alpha decay and as short as 3×10^{-13} sec following reactions involving heavy ions. (auth)

30765 VARYING THE ENERGY OF NEUTRON CAPTURE GAMMA RAYS FOR STUDIES OF PHOTONUCLEAR RESONANT SCATTERING. G. Ben-David (Davis), B. Arad (Huebschmann), and I. Pelah (Soreq Research Establishment, Rehovoth, Israel). Nucl. Instr. Methods, 26: 209-12 (Mar. 1964). (IA-842)

Two methods are discussed of varying the energy of neutron capture gamma rays for use in experiments on the resonant scattering of photons. In the first method a pulsed neutron source is used and the energy of the neutron causing the (n,gamma) reaction is varied by time of flight selection. In the second method the scattering target is rapidly rotated, causing a Doppler shift in the photon energy. It is shown that the latter technique has a higher counting rate, and the advantage of giving an equal shift in either positive or negative direction, which is of special importance for analyzing resonances found with gamma rays produced by thermal neutron capture. (auth)

30766 RESONANCE SELF-SHIELDING IN NEUTRON CAPTURE CROSS SECTION MEASUREMENTS. R. L. Macklin (Oak Ridge National Lab., Tenn.). Nucl. Instr. Methods, 26: 213-15(Mar. 1964).

The resonance self-protection correction for neutron capture is developed for a thin circular disc. Formulas suitable for calculation with a computer or desk calculator are derived. (auth)

30767 THE DESIGN OF ANGULAR DISTRIBUTION EXPERIMENTS. J. H. Williamson (Cambridge Univ., Eng.). Nucl. Instr. Methods, 26: 253-6(Mar. 1964).

In designing angular distribution experiments three criteria are adopted for an experiment of fixed duration: the accuracy in the coefficients needed to fit the experimental points is to be as great as possible; the coefficients are to be statistically independent; and the weights of the points are to be roughly equal. A method of quadratic programming is described, which will produce suitable sets of angles with their weights. It is of more general application and can be used to find the turning point of any quadratic function, the variables of which are subject to linear constraints. (auth)

30768 THE CORRECTION OF RESOLUTION DISTORTION IN CONTINUOUS PULSE-HEIGHT SPECTRA. D. E. Wortman and J. G. Cramer, Jr. (Indiana Univ., Bloomington). Nucl. Instr. Methods, 26: 257-62(Mar. 1964).

A method was devised for the correction of distortion effects arising from finite detector resolution in the measurement of continuous beta spectra. The correction procedure can, in principle, be used to correct distortions of any continuous spectrum measured with any spectrometer having a line-shape of fair resolution which can be measured or calculated. The method was applied to beta spectra measured with a 4π scintillation spectrometer. Internal conversion lines were used to determine the basic line-shape of the instrument, which was found to be Gaussian to a very good approximation. The beta spectra of two elements, ^{204}Tl and ^{91}Y, which have unique forbidden shapes were measured and corrected assuming the basic line-shape to be Gaussian. The correction procedure yields results compatible with the Fermi theory, and the experimental shape factor plots for these continuous beta spectra are in very good agreement with theoretical unique shape factors. (auth)

30769 HIGH RESOLUTION SECOND DIFFERENCE ANALYSIS OF PHOTONUCLEAR YIELD CURVES. K. N. Geller and E. G. Muirhead (Univ. of Pennsylvania, Philadelphia). Nucl. Instr. Methods, 26: 274-84(Mar. 1964).

A critical evaluation of the problems involved in the high resolution analysis of photonuclear cross sections from bremsstrahlung yield curves is presented. In particular, the effect of the analysis bin width and the shape of the x-ray spectrum are considered. A method is presented which circumvents the need to know the shape of the spectrum at the high energy tip; the latter information is contained in an effective energy resolution function that does not enter in the analysis, but for a normalization factor. The method, which is an iterative one, is based on taking the second difference of the photonuclear yield curve and is applicable to measurements made with bremsstrahlung in energy intervals less than 200 kev. An analytic smoothing procedure is used. The satisfactory performance of the method is demonstrated by the analysis of three synthesized yield curves. (auth)

30770 A RULE LIMITING THE COMPLEXITY OF (p,γ,γ) ANGULAR CORRELATIONS. R. Nordhagen (Universitetet, Oslo). Nucl. Instr. Methods, 26: 353-4(Mar. 1964).

It is shown that the analysis of (p,γ,γ) angular correlations in terms of statistical tensor occupations is preferable to a population number analysis. (C.E.S.)

30771 MEASUREMENT OF RECOIL-FREE FRACTIONS IN STUDIES OF THE MÖSSBAUER EFFECT. R. M. Housley, N. E. Erickson, and J. G. Dash (Univ. of Wash-

ington, Seattle). Nucl. Instr. Methods, 27: 29-37(Apr. 1964).

The techniques of measurement of recoil-free fractions f of resonance gamma rays are discussed. A theoretical analysis extends the validity of the resonance dip area method to permit relative f measurements to be made on emission lines of arbitrary shape. The method is also applicable to relative f' measurements on thin absorbers. Some forms of instrumental broadening do not affect the result. A discussion on background intensity measurements includes some techniques for making precise background corrections. Absolute f measurements are discussed in terms of a very wide absorption line, which can be considered to approach the ideal of a "black" resonance absorber. A mixture of fluoroferrates, having a composite line width of more than 1.4 mm/sec, was developed. The preparation of nearly black absorbers by compounding the mixture with iron enriched in ^{57}Fe is described in detail. The absorbers are so nearly ideal that many f measurements can be made simply, comparing intensities transmitted by a stationary absorber with the corrected intensity transmitted at high Doppler shifts. These absorbers were used to measure the f of 14.4-kev gamma rays of ^{57}Fe in Cu, Pt, and Be hosts at room temperature. The results are $f(Cu) = 0.175 \pm 0.021$, $f(Pt) = 0.736 \pm 0.023$; $f(Be \parallel$ to c axis$) = 0.805 \pm 0.028$; $f(Be \perp$ to c axis$) = 0.809 \pm 0.028$. Relative f measurements made with a potassium ferrocyanide absorber are in agreement with the ratios of the absolute f values. (auth)

30772 GAMMA-RAY ANGULAR CORRELATION ATTENUATION FACTORS. B. Herskind and Y. Yoshizawa (Universitet, Copenhagen). Nucl. Instr. Methods, 27: 104-8(Apr. 1964).

Gamma attenuation factors for angular correlations and angular distributions were computed from total absorption coefficients for a 76 × 76 mm NaI(Tl) crystal. The calculations cover the range of distances between a source and a crystal surface from 1 to 20 cm and the range of energies from 0.05 to 4.0 Mev. In order to determine attenuation factors for the photopeak alone, measurements were performed for gamma rays of 0.060 Mev (^{241}Am), 0.142 Mev (^{141}Ce), 0.32 Mev (^{51}Cr), 0.662 Mev (^{137}Cs), 1.332 Mev (^{60}Co), and 2.754 Mev (^{24}Na) within the same range of distances. The attenuation factors for the photopeak were computed by using the experimental results. The experimental factors are compared to the results calculated from the total absorption coefficients and to the results of the Monte Carlo calculation given by Yates. (auth)

30773 PHOTODISINTEGRATION OF Ca^{40}. J. E. E. Baglin and B. M. Spicer (Univ. of Melbourne). Nucl. Phys., 54: 549-60(June 1964).

The photoneutron yield from calcium was determined at 50 kev intervals from threshold to 20 Mev, and in 200 kev intervals up to 30 Mev. Positron activities were counted between betatron beam bursts. Analysis by the Penfold-Leiss method gives a cross section curve with some quantity of resolved structure. This structure is not readily describable in detail using current particle-hole interaction theories of the photodisintegration process in calcium. (auth)

30774 PARTIAL WAVE ANALYSIS OF THE HIGH ENERGY PICK-UP REACTION. Daphne F. Jackson (Battersea Coll. of Tech., London). Nucl. Phys., 54: 561-7(June 1964).

A distorted wave calculation on the (p,d) reaction at 95 and 145 Mev is carried out using a partial wave expansion for the distorted waves. The results are compared with those obtained earlier using a WKB approximation for the distorted waves. It is shown that results obtained using the WKB approximation are of doubtful validity, and that present uncertainties in the optical potential for the deuteron and in the form of the interaction obscure the interpretation of the data. (auth)

30775 THE DECAY OF 4.1 HOUR Zn^{71}. T. Sonnino, E. Eichler, and S. Amiel (Soreq Research Establishment, Yavne, Israel). Nucl. Phys., 54: 568-76(June 1964).

The decay of the 4.1 h isomer of ^{71}Zn was reinvestigated using scintillation spectrometry and coincidence counting techniques. In addition to the previously reported gamma rays of 0.385, 0.495, and 0.609 Mev, new gamma ray transitions were found with energies of 0.13, 0.21, 0.76, 0.92, 0.99, 1.11, 1.30, 1.37, 1.49, 1.64, 1.87, 1.96, and 2.4 Mev. An energy level scheme of ^{71}Ga is proposed. (auth)

30776 DETERMINATION OF THE MEAN PRIMARY CHARGE OF U^{235} FISSION PRODUCTS. P. Armbruster, D. Hovestadt, H. Meister, and H. J. Specht (Technische Hochschule, Munich). Nucl. Phys., 54: 586-614(June 1964).

Direct methods to determine the mean primary charge of fission products are discussed. Measurements of the mean primary charge for ^{235}U fission products were made using three different methods. The measured primary charge values are compared to those obtained from radiochemical results and to theoretical predictions describing asymmetric fission. A strong discrepancy with the radiochemical results was found. The mass dependence of the mean primary charge may be understood by assuming an influence of closed nucleon shells in the late stages of the fission process. (auth)

30777 FIRST-FORBIDDEN β-DECAYS OF Tl^{207} AND Pb^{209}. Joergen Damgaard and Aage Winther (Universitet, Copenhagen). Nucl. Phys., 54: 615-24(June 1964).

The ft values of the β decays of ^{207}Tl and ^{209}Pb are computed. These decays involve only nuclei with double-closed shells plus or minus one nucleon for which the wave functions are known rather accurately. It is shown that the β-decay matrix elements depend sensitively on details of the electron wave function inside the nucleus. When proper account is taken of the theorem of the conserved vector current one finds results which indicate that polarization effects in the closed shells reduce the single-particle matrix elements by a factor of two. The computations can be checked by a measurement of the β-spectrum shapes. (auth)

30778 PHOTOALPHA REACTIONS BELOW 21.5 Mev WITH ^{14}N AND ^{16}O. M. Elaine Toms (Naval Research Lab., Washington, D. C.). Nucl. Phys., 54: 625-40(June 1964).

Cross-section measurements integrated to 21.5 Mev were made for the $^{14}N(\gamma,\alpha)^{10}B$ reaction, the $^{16}O(\gamma,\alpha)^{12}C$ reaction and the $^{16}O(\gamma,4\alpha)$ reaction with the assumption that ^{10}B and ^{12}C were left in their ground states. The values for the single-alpha events are 0.74 ± 0.11 Mev · mb for ^{14}N and 0.055 ± 0.008 Mev · mb for ^{16}O. The value for the four-alpha events is 0.124 ± 0.017 Mev · mb. Partial cross sections for the distinct modes of ^{16}O breakup into two ^{8}Be nuclei both in the ground state, and via the 7.7-Mev state of ^{12}C, are 0.015 ± 0.006 and 0.053 ± 0.011 Mev · mb, respectively. The distribution in angle between the alpha and the photon direction for the $^{16}O(\gamma,\alpha)^{12}C$ reaction (^{12}C assumed to be in its ground state) gives an E2/E1 intensity ratio of 0.3 while for the 7.7-Mev state the ratio is 0.2. The smallness of the cross section for

the photodisintegration of ^{16}O yielding an alpha or four alphas, being 0.18 ± 0.02 Mev · mb, agrees with the strongly inhibiting effects of $\Delta T = \pm 1$ for E1 absorption and for no change in T for alpha decay. (auth)

30779 ENERGY LEVELS AND TRANSITION PROBABILITIES FOR DEFORMED NUCLEI. B. J. Verhaar (Technische Hogeschool, Eindhoven, Netherlands). Nucl. Phys., 54: 641-56(June 1964).

Higher-order energy corrections and intensity rules for K-allowed and K-forbidden transitions are discussed on the basis of a generalized Peierls-Yoccoz theory, which includes K mixing. The results put a number of predictions of the rotational model on a firmer basis, but show in addition some marked differences. A comparison with experimental data is given. (auth)

30780 A REVISED SCHEME FOR THE BETA DECAY OF 115-DAY Ta^{182}. P. G. Hansen, H. L. Nielsen, and K. Wilsky (Atomenergikommissionen, Risø, Denmark). Nucl. Phys., 54: 657-64(June 1964).

A six-gap beta spectrometer, a xenon-filled proportional counter, scintillation equipment, and coincidence techniques were used in a reinvestigation of the beta transitions to the known levels in ^{182}W. The main beta component of 522 kev (65%) is shown to proceed to the level at 1290 kev and not, as hitherto believed, to the 1222-kev level. The investigation further revealed two new β components of higher energy: 591 kev (0.9 ± 0.5)% and 1708 kev (0.05 ± 0.01)%. The 1708-kev transition represents a new example of K-forbidden $3^- \rightarrow 2^+$ beta transitions in the rare-earth region. (auth)

30781 THE $2^- \rightarrow 2^+$ FIRST-FORBIDDEN BETA DECAY OF Pr^{142}. R. Hess, P. Lipnik, Chs.-Fs. Perdrisat, and J. W. Sunier (Federal Inst. of Tech., Zurich). Nucl. Phys., 54: 673-82(June 1964).

The first-forbidden 0.57-Mev β transition of ^{142}Pr was studied. The measurement of the β spectrum shows a statistical shape. The β-γ directional correlation involving the subsequent 1.57-Mev γ ray was found to be isotropic within the limits of experimental error. The measurement of the β-γ circular polarization correlation determines the ratio of the linear combination of zero- and first-order matrix elements to be $V/Y = -0.2$ or -2.7. These results support very well the assumption of the validity of the ξ-approximation for this transition. A simple shell-model description of the involved states favors the first solution for V/Y. (auth)

30782 ANGULAR CORRELATIONS OF GAMMA CASCADES IN Kr^{82}. L. Simons, S. Bergstroem and A. Anttila (Univ. of Helsinki). Nucl. Phys., 54: 683-8(June 1964).

The gamma rays that follow the decay of ^{82}Br were investigated. A new level of energy 2430 kev was found. Six angular correlations were measured, of which four were not investigated earlier: 1042-777, 832-1042, 832-(1042)-777, and 617-700 kev. The correlations made it possible to exclude the spin possibility 3 for the 1821-kev level, and thus 4^+ is assigned to this level. The M3 admixture in the 1042-kev transition and the M2 admixture in the 832-kev transition were found to be very small. The E2/M1 mixing parameters of the 617- and 700-kev gamma rays were determined as -2.6 ± 0.4 and -2.9 ± 1.8, respectively. (auth)

30783 A STUDY OF THE $Be^9(He^3,\gamma)C^{12}$ REACTION. J. L. Black (Oxford Univ.), G. A. Jones, and P. B. Treacy. Nucl. Phys., 54: 689-93(June 1964).

Gamma rays were detected from bombardment of thin ^9Be targets with beams of 1.5 to 4.5 Mev ^3He ions. Transitions are identified via $^9Be(^3He,\alpha)$ to the 17.6-Mev level of ^8Be, and via $^9Be(^3He,\gamma)$ to the ground state and first-excited state of ^{12}C. Absolute 90° differential cross sections for the latter process were measured. The absence of any observed transitions to a 10.1-Mev level in ^{12}C is discussed. (auth)

30784 SCATTERING KERNEL FOR BERYLLIUM. James A. Young and Juan U. Koppel (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Nucl. Sci. Eng., 19: 367-73(July 1964).

Using a central-force model, with experimentally determined force constants, the lattice vibrational spectrum of beryllium was determined from a sampling of 2413 points in the first Brillouin zone. The specific heat derived from this spectrum agrees well with measured values. This vibrational spectrum was used to compute the inelastic scattering of slow neutrons from beryllium in the incoherent approximation. Agreement with experiment is good in the region of high momentum transfer where this approximation applies. The coherent elastic scattering depends on the vibrational spectrum, and this was also computed. (auth)

30785 AN ANALYSIS OF A NUCLEAR SCATTERING RESONANCE BY THE REGGE REPRESENTATION. M. Carrassi and G. Passatore (Università, Genoa and Isituto Nazionale di Fisica Nucleare, Genoa). Nuovo Cimento (10), 32: 1337-47(June 1, 1964).

A nuclear resonance scattering process was analyzed by using the one-pole approximation to the Regge representation. It is shown that in general the background integral is very important and may be neglected only for sufficiently backward angles. The qualitative features of the Regge trajectory near the resonance energy are deduced, and their physical consequences are discussed. (auth)

30786 HYPERFINE EFFECTS IN MUON CAPTURE. J. Delorme (Université, Lyon). Nuovo Cimento (10), 32: 1360-75(June 1, 1964).

A derivation is given of the capture rates λ_+ and λ_- in the two hyperfine states of a muonic atom. Explicit forms of the matrix elements are given for the nuclear shell model. It is shown that the transition $^6Li + \mu^- \rightarrow {}^6He + \nu$ is very suitable for measuring the effective coupling constants G_A and G_P. (auth)

30787 AN EXAMPLE OF THE π^+ DECAY OF $^7Li_\Lambda$ OR $^7Be_\Lambda$ HYPERFRAGMENT. D. T. Goodhead, A. Z. M. Ismail, S. Lokanathan, and Y. Prakash (Oxford Univ.). Nuovo Cimento (10), 32: 1445-7(June 1, 1964).

The π^+ decay of a hyperfragment was observed in the study of meson (K^-) interactions in a K5 emulsion at 3.5 Bev/c. The hyperfragment was produced in a (13 + 3) prong K^- star and decayed at rest into three charged particles. The identity of the hyperfragment as $^7Li_\Lambda$ or $^7Be_\Lambda$ seems to be equally probable as a result of experimental uncertainty. (C.E.S.)

30788 NEUTRON-PROTON INTERACTION IN Nb^{92}. S. P. Pandya (Argonne National Lab., Ill.). Phys. Letters, 10: 178-9(June 1, 1964).

The analysis of the energy levels of ^{92}Nb on the basis of recent experimental findings, using Slater integrals to express the matrix elements of the n-p interaction ($g_{9/2}$, $d_{5/2}$ configuration), is discussed. Consideration of the Slater integrals indicates that the spin-dependent and -independent terms of the interaction have similar radial shape and range. The n-p interaction also has a finite, nonzero range. The results of an evaluation of the ($g_{9/2}$,$d_{5/2}$) energy levels are presented and compared. (D.C.W.)

30789 THE ORBITAL YOUNG DIAGRAM AS A SHELL MODEL QUANTUM NUMBER IN LIGHT NUCLEI AND SOME CLUSTER PHENOMENA IN NUCLEAR REACTIONS. V. G. Neudachin (Universitet, Copenhagen), V. G. Shevchenko, and N. P. Yudin. Phys. Letters, 10: 180-2(June 1, 1964).

The general cluster decay rules of some excited states of p-shell nuclei, which are based on the Young diagram, are discussed in relation to experimental observations and calculations. (D.C.W.)

30790 ON THE COUPLING BETWEEN DIPOLE AND QUADRUPOLE OSCILLATIONS OF ATOMIC NUCLEI. S. F. Semenko (Lebedev Inst. of Physics, Moscow). Phys. Letters, 10: 182-4(June 1, 1964).

The coupling of dipole transverse vibrations with gamma vibrations in spheroidal even-even nuclei and of dipole and surface oscillations in spherical even-even nuclei is considered in the strong-coupling limit. For the former situation, the polarizabilities describing the Raman scattering to the first gamma vibrational level are obtained. In the latter case, polarizability expressions describing the elastic scattering and the Raman scattering to the first and second 2^+ level are derived. The effects of zero-point vibrations are determined. An approximate formula for the polarizabilities is also presented. (D.C.W.)

30791 OBSERVATIONS OF THE MÖSSBAUER EFFECT USING COINCIDENCE TECHNIQUES. W. J. Nicholson (Columbia Univ., New York). Phys. Letters, 10: 184-6 (June 1, 1964).

A coincidence method for detecting resonant absorption in low-lying excited states above the first is described. A Mössbauer velocity spectrum obtained for the second excited state of ^{161}Dy in Dy_2O_3 is discussed in relation to conventional observations on both the first and second excited states. (D.C.W.)

30792 EXCITATION OF LOW-LYING LEVELS IN Ca^{40} BY (p,p') SCATTERING AT E_p = 55 Mev. K. Yagi (Tokyo Univ.), H. Ejiri, M. Furukawa, et al. Phys. Letters, 10: 186-91(June 1, 1964).

Proton groups corresponding to excitation energies of 0, 3.7 ± 0.05, 4.5 ± 0.05, 5.4 ± 0.05, 6.3 ± 0.1, 6.9 ± 0.1, 8.1 ± 0.1, and 8.6 ± 0.1 Mev were observed. Optical model calculations gave a satisfactory fit to the angular distribution for elastically scattered protons. The angular distributions for inelastic scattering to the 3.7, 4.5, and 6.9 Mev levels were analyzed in the first-order distorted-wave Born approximation, using nonspherical optical model potentials suggested by the collective vibrational model. Two interaction types were used: a real interaction in which only the real part of the optical potential is deformed and a complex interaction in which both the real and imaginary parts are deformed assuming equal deformabilities. Both surface and volume imaginary potentials were used. Deformabilities and reduced transition rates were also calculated. (D.C.W.)

30793 ON THE POSSIBLE CORE-POLARIZATION EFFECTS IN THE MAGNETIC MOMENTS OF STATES IN Pb^{207}. S. Gustafsson, K. Johansson, E. Karlsson, and A. G. Svensson (Uppsala Univ.). Phys. Letters, 10: 191-2(June 1, 1964).

The magnetic moment of the 570-kev, $\frac{5}{2}$ state in ^{207}Pb was determined from the shift of the γ-γ angular correlation in a strong magnetic field (50,600 gauss). The 1064-570 kev cascade was used, and g and μ were found to be 0.34 ± 0.05 and 0.84 ± 0.12, respectively. The possibility that deviations in μ for nuclear states around A = 208 could be explained by a polarization of the spins of the nuclear core that effectively reduces the contribution from the spin magnetism of the odd quasiparticle was considered. Limited calculations of μ for the $\frac{5}{2}$ state on this basis gave a value far smaller than the experimental value. (D.C.W.)

30794 ANOMALOUS PARITY STATES IN MASS-9 NUCLEI. R. Reif (Central Inst. of Nuclear Research, Rosendorf, Ger.). Phys. Letters, 10: 193-4(June 1, 1964).

The shell model developed by Talmi was used to investigate the existence of $\frac{1}{2}^+$ states in mass-9 nuclei. Energy calculations for ^9Be indicate two $\frac{1}{2}^+$ states in ^9Be at 1.3 and 10.9 Mev, the latter of which may be identified with an observed 11.3-Mev level. Conclusions from the unified model on the existence of a $\frac{1}{2}^+$ level in ^9Be are also mentioned. (D.C.W.)

30795 THE EFFECTIVE INTERACTION AND IDENTICAL-NUCLEON SENIORITY FOR NUCLEI NEAR Zr^{90}. S. Cohen (Argonne National Lab., Ill.), R. D. Lawson, M. H. MacFarlane, and M. Soga. Phys. Letters, 10: 195-8(June 1, 1964).

The results of shell model calculations for fifty-neutron nuclei near mass 90 are presented. The neutrons were assumed to remain in an inert closed-shell configuration, while the protons fill the $1g_{9/2}$ and $2p_{1/2}$ single-particle orbits. The nine independent two-body matrix elements involving the $1g_{9/2}$ and $2p_{1/2}$ levels and the binding energies of protons in these levels to the ^{88}Sr core were treated as independent parameters, which were determined by a least squares fit to 20 measured binding energies and level positions in ^{89}Y, ^{90}Zr, ^{91}Nb, ^{92}Mo, and ^{93}Tc. An effective interaction was obtained that conserves seniority to a notable extent. Close agreement with experimental data on the five nuclei was obtained. (D.C.W.)

30796 FINITE ENERGY RANGE AND MODULATION EFFECTS IN THE ANALYSIS OF CROSS-SECTION FLUCTUATION DATA. I. Hall (Oxford Univ.). Phys. Letters, 10: 199-201(June 1, 1964).

Some difficulties in the comparison of theoretical predictions and experimental data are examined. The effects of finite energy range and of energy dependence of the average fluctuating compound cross section or a direct reaction contribution to the cross section are considered. (D.C.W.)

30797 EVIDENCE FOR THE ISOTOPIC SPIN ASSIGNMENT T = 0 FOR THE LEVEL AT 16.93 Mev IN Be^8. P. Paul, S. L. Blatt, and D. Kohler (Stanford Univ., Calif.). Phys. Letters, 10: 201-4(June 1, 1964).

The isotopic spin assignments of the 16.62 and 16.93-Mev levels in ^8Be were studied by exciting the 17.64-Mev level in proton bombardment of ^7Li and detecting gamma transitions to the two lower levels by observing breakup of these levels into two alpha particles. The observations indicate a probable T = 0 assignment for the 16.93-Mev level and suggest an assignment of T = 1 for the 16.62-Mev level. (D.C.W.)

30798 SPLITTING OF SINGLE-PARTICLE STATES IN Sc^{49}. D. D. Armstrong and A. G. Blair (Los Alamos Scientific Lab., N. Mex.). Phys. Letters, 10: 204-7(June 1, 1964). (LADC-6399)

Deuteron spectra for the stripping reaction $^{48}Ca(^3He,d)$, which excites ^{49}Sc states containing single-particle configurations, were obtained with an ^3He energy of 22 Mev. The Q values for the deuteron groups were determined and were used to obtain the excitation energies. The angular distributions for all but the weakest deuteron groups were also measured and compared with zero-range, distorted-wave calculations. The results are consistent with a $1f_{7/2}$ single-particle assignment to the ground state; but show that the

$2p_{\frac{3}{2}}$, $1f_{\frac{5}{2}}$, and $2p_{\frac{1}{2}}$ single-particle states are split over several energy levels and that no significant component of these states appears below 3 Mev of excitation. (D.C.W.)

30799 POLARIZATION OF PHOTONEUTRONS FROM Bi. A. De Marco, R. Garfagnini, and G. Piragino (Universita, Turin and I.N.F.N., Turin). Phys. Letters, 10: 213-14(June 1, 1964).

Neutrons emitted from Bi under exposure to 80-Mev gamma rays were detected by the recoil method in a diffusion cloud chamber. Two neutron energy groups ($0.4 < E \leq 4$ Mev and $4 < E \leq 16$ Mev) were observed, composed mainly of evaporation neutrons and direct interaction neutrons, respectively. A maximum likelihood estimation of the polarization of the two groups of photoneutrons gave values of 0.14 ± 0.10 and 0.20 ± 0.21, respectively. (D.C.W.)

30800 A MEASUREMENT OF THE DEPOLARIZATION IN MATTER OF LONGITUDINALLY POLARISED POSITRONS. L. Dick, L. Feuvrais, L. Di Lella, and M. Spighel (CERN, Geneva). Phys. Letters, 10: 236-9(June 1, 1964).

A meson (π^+) beam was moderated by carbon and came to rest in Be. Positrons produced in the $\pi^+ + \mu^+ + e^+$ decay chain were injected by a 90° magnetic spectrometer into a polarization analyzer. Observations were also made on e^+ from ^{8}B and ^{22}Na decay. The results were compared favorably with theoretical predictions of Bouchiat. The results, together with previous results, indicate the presence of a depolarization mechanism in the slowing down of longitudinally polarized positrons from 45 to 10 Mev in Be. (D.C.W.)

30801 DECAY OF Os^{194}. David C. Williams and Robert A. Naumann (Princeton Univ., N. J.). Phys. Rev., 135: B289-93(July 27, 1964). (PPAD-509E)

The ^{194}Os was produced by neutron irradiation of Os metal; its half-life was measured to be 5.8 ± 0.4 years. The radiations accompanying the decay of chemically purified ^{194}Os sources were investigated by using scintillation and proportional-counter spectrometers. The total beta decay disintegration energy is 97 ± 2 kev. Two electromagnetic transitions, both predominantly M1, accompany ^{194}Os decay, with energies of 42.8 ± 0.2 (abundance = $27 \pm 5\%$) and 82.3 ± 1.0 kev (abundance = $4.8 \pm 1.0 \times 10^{-2}\%$). It appears that these result from beta decay branches directly populating levels in ^{194}Ir at these energies. The decay data indicate spins and parities of either 0- or 1- for these two states. The observed levels are compared with those to be expected for odd-odd nuclei in this mass region. (auth)

30802 SEARCH FOR DOUBLE GAMMA-RAY EMISSION FROM THE FIRST EXCITED STATES OF O^{16} AND C^{12}. D. E. Alburger and P. D. Parker (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 135: B294-300 (July 27, 1964). (BNL-7872)

Two-dimensional pulse-height analysis was used to search for double gamma-ray emission in competition with the E0 (π) decay of the 6.05-Mev state in ^{16}O and in competition with the E2 gamma decay of the 4.43-Mev state in ^{12}C. In each case two 5-in. x 5-in. NaI crystals viewed the target located at the center of a double-conical lead-Hevimet absorber, and the outputs of these detectors were connected to a 64×64 two-dimensional, pulse-height analyzer. Coincidence patterns were analyzed for the presence of a line of constant sum-energy with an intensity distribution peaked at the center in accordance with the theoretical $E^3(E_0 - E)^3$ distribution. In neither case was any evidence obtained for such a pattern. Upper limits of $\Gamma_{E1E1}/\Gamma_{E0(\pi)} \leq 1.1 \times 10^{-4}$ for the 6.05-Mev state of ^{16}O and of $\Gamma_{E1E1}/\Gamma_{E2} \leq 0.5 \times 10^{-4}$ for the 4.43-Mev state ^{12}C were derived. (auth)

30803 LIFETIME AND MULTIPOLARITY MEASUREMENTS IN Cs^{131}. D. J. Horen (Naval Radiological Defense Lab., San Francisco and Univ. of California, Berkeley), J. M. Hollander, and R. L. Graham. Phys. Rev., 135: B301-10(July 27, 1964). (UCRL-10943)

Using the $\sqrt{2\pi}$, iron-free, beta spectrometer, the half-life of the 78.69-kev state in ^{131}Cs was measured to be 9.6 ± 0.3 nsec and that of the 133.54-kev state was redetermined to be 9.3 ± 0.3 nsec. An upper limit of ≤ 0.4 nsec was found for the halflife of the 216.01-kev state. L-subshell ratios and multipolarity assignments based thereon are given for a number of transitions in ^{131}Cs. A new transition with an energy of 969.1 kev was observed, and the 461-kev transition was found to consist of a doublet with energies of 461.3 and 462.9 kev. The data indicate that the ground ($\frac{5}{2}$+) and 78.69-kev ($\frac{7}{2}$+) states of ^{131}Cs probably arise from different intrinsic states ($d_{\frac{5}{2}}$ and $g_{\frac{7}{2}}$, respectively) upon which are based collective levels located at 123.73 and 133.54 kev. Tentative spin and parity assignments are included. Poor agreement is found with existing theoretical predictions. (auth)

30804 ELECTRON SCREENING CORRECTIONS TO BETA-DECAY SPECTRA. Loyal Durand, III (Yale Univ., New Haven). Phys. Rev., 135: B310-13(July 27, 1964).

The corrections to the Fermi function F(Z,W) which arise from the screening of the Coulomb field of the nucleus by the atomic electrons were investigated using a Hulthén model for the screened field. The resulting problem is exactly solvable for the Schrödinger and Klein-Gordon equations. The results agree with those obtained by Rose and by Longmire and Brown using a modification of the WKB method and disagree markedly with those obtained by Reitz by numerical integration of the Dirac equation. The latter results appear to be incorrect. (auth)

30805 BOUND ON SCREENING CORRECTIONS IN BETA DECAY. Lowell S. Brown (Yale Univ., New Haven). Phys. Rev., 135: B314-19(July 27, 1964).

A determinantal method is used to provide a rigorous bound on the screening corrections in beta decay in the nonrelativistic approximation. The results demonstrate that a previous numerical calculation of these corrections is inaccurate. (auth)

30806 EMPIRICAL SCREENING CORRECTION FOR M-SUBSHELL INTERNAL CONVERSION COEFFICIENTS. Y. Y. Chu and M. L. Perlman (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 135: B319-24(July 27, 1964). (BNL-7865)

The only theoretical values which are available for coefficients of internal conversion in the M shell were calculated without the inclusion of screening and are in disagreement with experimental values by factors as large as 3. From the comparison of these theoretical values with new accurate measurements on the M-subshell electron lines of the M4 transitions occurring in the decay of ^{121m}Te and of ^{123m}Te, a tentative semiempirical screening correction was obtained. Essentially, this is the replacement of the nuclear charge Z for the evaluation of the coefficient by $Z_{effM} = Z - \sigma_i$, where $\sigma_i = 7.0$, 7.9, and 10.0 for M_I(3s), $M_{II,III}$ (3p), and $M_{IV,V}$ (3d) electrons, respectively. This correction to the theoretical values is found to produce agreement with other experimental M conversion results over a wide range of multipolarities, Z, and energy values. The nonspecific characteristic of the correction is interpreted to mean that the screening is chiefly an effect on the electron wave functions of the initial bound states of the atom. (auth)

30807 ENERGY LEVELS IN Sn^{122}, Sn^{123}, Sn^{124}, AND Sn^{125}. Carson L. Nealy and Raymond K. Sheline (Florida State Univ., Tallahassee). Phys. Rev., 135: B325-9 (July 27, 1964).

The energy levels of ^{122}Sn, ^{123}Sn, ^{124}Sn, and ^{125}Sn were studied using the reactions $^{122}Sn(d,p)^{123}Sn$, $^{122}Sn(p,p')^{122}Sn$, $^{124}Sn(d,p)^{125}Sn$, and $^{124}Sn(p,p')^{124}Sn$. Protons resulting from 11- to 12-Mev protons and deuterons incident on separated Sn isotopes were analyzed in a broad range magnetic spectrograph. The Q values of the (d,p) reactions on ^{122}Sn and ^{124}Sn are 3726 ± 12 and 3506 ± 12 kev, respectively. There are considerable differences between the level structure observed in these studies and those of Cohen and Price for ^{123}Sn and ^{125}Sn, largely due to the higher resolution available in this experiment. (auth)

30808 INELASTIC PROTON SCATTERING AT 40 Mev. Tannie Stovall and Norton M. Hintz (Univ. of Minnesota, Minneapolis). Phys. Rev., 135: B330-45(July 27, 1964).

Energy spectra of protons scattered from ^{7}Li, ^{12}C, ^{27}Al, ^{40}Ca, ^{54}Fe, ^{56}Fe, ^{58}Ni, ^{60}Ni, ^{63}Cu, ^{206}Pb, ^{207}Pb, and ^{208}Pb were obtained. Angular distributions were taken on the strongly excited states of ^{12}C, ^{24}Mg, ^{54}Fe, ^{56}Fe, ^{58}Ni, ^{60}Ni, and ^{208}Pb. The Blair phase rule is found to apply moderately well when a pronounced diffraction structure exists in the angular distributions. It is found that the McCarthy-Kromminga rule for the determination of parities of nuclear states from the small angle behavior of the angular distributions has limited validity. The B(EL)'s obtained from proton inelastic scattering measurements, using a distorted-wave Born approximation analysis, agree fairly well with the values obtained by electromagnetic methods. (auth)

30809 ELASTIC AND INELASTIC SCATTERING AT 168 Mev IN THE $O^{16}-C^{12}$ SYSTEM. J. C. Hiebert and G. T. Garvey (Yale Univ., New Haven). Phys. Rev., 135: B346-57(July 27, 1964).

The differential cross sections for elastic scattering and inelastic scattering to the most strongly excited states in the $^{16}O-^{12}C$ system were measured using a 168-Mev ^{16}O beam. The states most strongly excited are the 2^+ state in ^{12}C at 4.43 Mev and the 3^- state in ^{16}O at 6.14 Mev. The mutual excitation reaction wherein both these levels are excited (Q = −10.57 Mev) was also observed and measured. All of the angular distributions measured have an oscillatory behavior, a consequence of the strong absorption of the incident wave in the nuclear interior and indicative of a direct interaction mechanism. A distorted-wave Born approximation analysis of the data is obtained in order to extract reliable nuclear parameters. The results of this experiment are compared to previous elastic and inelastic scattering from ^{12}C in the adiabatic-Fraunhofer limit. Fair agreement is noted in spite of the variety of projectiles used in the comparison. The transition strengths for inelastic scattering are further compared to the electromagnetic transition probabilities, and a scheme for relating the two quantities is presented. (auth)

30810 PROTON CAPTURE RADIATION FROM Ca^{40} IN THE REGION OF THE GIANT RESONANCE. J. C. Hafele, F. W. Bingham, and J. S. Allen (Univ. of Illinois, Urbana). Phys. Rev., 135: B365-70(July 27, 1964).

The 90° differential cross section for radiative proton capture to the ground state of ^{40}Ca was measured at 6 to 15 Mev, corresponding to ^{40}Ca excitation energies of 14 to 23 Mev. A giant resonance near the excitation energy of 19 Mev with a width of about 3 Mev occurs in the $^{39}K(p,\gamma_0)^{40}Ca$ reaction. The giant resonance is split into eight resolved fine structure peaks between 18 and 22 Mev, and subsidiary peaks appear below the giant resonance at 15.2 and 16.2 Mev. This experiment extends the region of excitation energies studied in previous experiments, and the results are in agreement in the region of overlap. The pulse-height spectra from the gamma spectrometer show a secondary gamma peak with an energy corresponding to the energy of the radiation from transitions to one or more of the first four excited states of ^{40}Ca. The gamma rays from the individual excited-state transitions were unresolved in this experiment. The area under the secondary peak is taken as the yield of gamma rays from the $^{39}K(p,\gamma_1+\gamma_2+\gamma_3+\gamma_4)^{40*}Ca$ reactions. The combined relative differential cross section for these reactions increases with energy by a factor of two over the range of excitation energies studied. (auth)

30811 EVAPORATION OF ALPHA PARTICLES IN THE INTERACTION OF HIGH-ENERGY PROTONS WITH AgBr. Norbert T. Porile (McGill Univ., Montreal and Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 135: B371-7 (July 27, 1964). (BNL-7811)

The energy spectra, angular distributions, and multiplicities of alpha particles evaporated in the actions on AgBr of 1- and 2-Bev protons were calculated. A Monte Carlo evaporation calculation was combined with the results of the cascade calculation of Metropolis. Special attention was paid to the motion of the evaporating nuclei, and the calculated spectra are obtained in the laboratory system. The results are compared with the experimental data of Katcoff; good overall agreement is noted. In particular, the agreement of the calculated and experimental energy spectra below 15 Mev indicates that it is not necessary to invoke the principle of barrier reduction at high-excitation energies to account for the emission of low-energy alpha particles. The calculation predicts too few alpha particles with energies above 25 Mev, and it is concluded that the cascade process accounts, in part, for the high-energy portion of the spectrum. (auth)

30812 ELECTRON AND MUON SCATTERING FROM NUCLEAR CHARGE DISTRIBUTIONS AT INCIDENT MOMENTA BETWEEN 50 AND 183 Mev/c. C. R. Fischer (Adelphi Univ., Garden City, N. Y.) and G. H. Rawitscher. Phys. Rev., 135: B377-83(July 27, 1964).

The comparison of theoretical elastic-scattering cross sections of positrons and electrons from Woods-Saxon (WS) and "wine-bottle" (WB) charge distributions of the nucleus of Au, previously performed for 183 Mev, is extended to lower energies and repeated for muons of comparable incident momenta. It is found that, for momentum transfers of less than 1.5 F^{-1}, the percent change of the cross section corresponding to a change from the WS to the WB charge distribution is largest, of the order of 30% for incident momenta of ~100 Mev/c, particularly for positrons. At an electron energy of 50 Mev, the cross section depends mainly on the mean-square radius of the nucleus; and an accuracy better than 5% is needed in order to determine additional nuclear charge distribution parameters. The mean-square radii of the WS and WB charge distributions differ by 6.5%, while the corresponding electron cross sections at 50 Mev differ by a maximum of 15%. A comparison with experimental elastic positron and electron scattering cross sections for Pb measured by Miller and Robinson is carried out; and a systematic discrepancy with theory is found for both e^+ and e^- cross sections for the 50−70 Mev energy range, while theory and experiment agree well at 87 Mev and higher energies. The calculation consists of a conventional numerical phase-shift analysis based on the Dirac equation, and the nuclei are assumed to be static, spherically symmetric, extended charge distributions. (auth)

30813 NEUTRON BINDING ENERGIES IN HEAVY NUCLEI. B. L. Cohen, R. Patell, A. Prakash, and E. J. Schneid (Univ. of Pittsburgh). Phys. Rev., 135: B383-8 (July 27, 1964).

Neutron binding energies in 53 nuclei of mass 81–209 were determined with 15-kev accuracy by measurements of Q values for (d,p) and (d,t) reactions. In seven cases, there are large discrepancies with previously accepted values; these are discussed in detail. There are strong indications of subshell closure at 56 neutrons in Zr and at 64 neutrons in Sn, but these indications are much weaker at 56 neutrons in Mo and are nonexistent at 64 neutrons in Cd. (auth)

30814 SHELL-MODEL STATES AND CONFIGURATION MIXING IN THE Ti ISOTOPES BY THE (p,d) REACTION. E. Kashy and T. W. Conlon (Princeton Univ., N. J.). Phys. Rev., 135: B389-401(July 27, 1964). (PUC-1964-127)

The energy spectra and angular distributions of deuterons resulting from the bombardment of ^{46}Ti, ^{47}Ti, ^{48}Ti, ^{49}Ti, and ^{50}Ti with 17.5-Mev protons were measured. For even-A targets, one strong transition is observed, while for odd-A targets a large number of levels are strongly excited. The deuteron angular distributions show that these strong transitions are due to the pickup of an $l_n = 3$ neutron. A number of even-l transitions corresponding to the pickup of neutrons from the already filled $1d_{\frac{3}{2}}$ and $2s_{\frac{1}{2}}$ shells were also observed. The Q values for the pickup of $l_n = 2$ neutrons from the even-A Ti isotopes show an interesting feature, in that they are found to be approximately independent of the Ti isotope used. A few $l_n = 1$ transitions were also observed, indicating p-wave admixture in the ground level wave functions of the target nuclei. By comparison of the experimental result with DWBA calculation, spectroscopic factors were calculated for the transitions observed. The spectroscopic factors and excitation energies for $l_n = 3$ transitions were compared to recent theoretical predictions in which it is assumed that protons and neutrons in excess of 20 can be treated as belonging to a pure $(1f_{\frac{7}{2}})^n$ configuration. (auth)

30815 ISOMER RATIOS FROM $(\alpha,\chi n)$ REACTIONS ON SILVER. C. T. Bishop (Argonne National Lab., Ill.), J. R. Huizenga, and J. P. Hummel. Phys. Rev., 135: B401-11 (July 27, 1964).

The excitation functions for the ^{107}Ag$(\alpha,n)^{110,110m}$In and ^{109}Ag$(\alpha,3n)^{110,110m}$In reactions were measured with isotopically separated targets. The excitation functions for the high-spin metastable state peak in both reactions at higher bombarding energies than the low-spin ground state. In the case of the ^{107}Ag(α,n) reaction, the cross section for the formation of ^{110}In peaks at a helium-ion energy of about 17 Mev and that for ^{110m}In peaks at about 19.5 Mev. The isomer ratio, $\sigma_m/(\sigma_m + \sigma_g)$, determined for the ^{107}Ag(α,n) reaction varies from 0.13 at a helium-ion energy of 10.8 Mev to 0.81 at 22.0 Mev. In the ^{109}Ag$(\alpha,3n)$ reaction, this ratio varies from 0.68 at a helium-ion energy of 27.6 Mev to 0.87 at 38.7 Mev. The experimental cross sections are based on measured half lives of 70.2 ± 1.4 min and 5.2 ± 0.2 h for ^{110}In and ^{110m}In, respectively. The isomer ratios for the above reactions were calculated and the effects of various parameters on the calculations were examined. The experimental isomer ratios for the ^{107}Ag(α,n) reaction for bombarding energies below 18 Mev agree within experimental uncertainties with calculated results based on either a Fermi-gas model with a rigid moment of inertia ($\sigma^2 = 34.7t$) or a superconductor model. A superconductor model predicts only about a 20% reduction in the moment of inertia for ^{110}In, and such a small change could not be definitely established from the data. A marked increase in the experimental isomer ratios from the ^{107}Ag(α,n) reaction is observed near the onset of the $(\alpha,2n)$ reaction. This increase is probably due to a fractionation of the intermediate spin distribution for energies slightly exceeding the threshold of a second reaction. This effect is suggested also in the ^{109}Ag$(\alpha,3n)$ reaction by the small experimental isomer ratios at bombarding energies for which the $(\alpha,2n)$ competition is sizable. These results indicate that values of σ deduced from the isomer ratio technique are in error at energies where cross sections for a competing reaction are large. (auth)

30816 SCATTERING AND POLARIZATION OF NEUTRONS FROM Al, Si, Fe, AND Co AT 2 Mev. D. J. Bredin (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 135: B412-16(July 27, 1964). (BNL-7499; CONF-46-111)

The angular distributions of the elastic scattering and polarization from $\theta = 30$ to 120° were obtained for Al, Si, Fe, and Co at 1.95 ± 0.09 Mev, using polarized neutrons from the T(p,n)^{3}He reaction. Scattering and polarization from the 0.845–Mev level of ^{56}Fe were also measured; an isotropic angular distribution and zero polarization were found for this level. The angular distributions of the elastic polarization for Si, Fe, and Co were negative at forward and backward angles with two zero cross-over points; the first zero of the polarization occurs approximately at the minimum of the elastic scattering for these three elements. In distinct contrast, the angular distribution of the polarization for Al is positive and constant at forward angles, becoming negative at backward angles. Absolute cross sections were obtained by scattering from polyethylene, and an optical-model analysis of the experimental results was made. (auth)

30817 CALCULATION OF MAGNETIC HYPERFINE CONSTANT OF P^{31}. N. Bessis (Centre de Mécanique Ondulatoire Appliquée, Paris), H. Lefebvre-Brion, C. M. Moser, A. J. Freeman, R. K. Nesbet, and R. E. Watson. Phys. Rev., 135: A588-90(Aug. 3, 1964).

The results of different kinds of calculations, which use the concept of spin polarization, all predict a negative sign of the magnetic hyperfine constant of the ^{4}S ground state of ^{31}P in contradiction with the sign deduced by Lambert and Pipkin from an optical pumping experiment. This result means that either an error in experimental sign was made or that the first serious breakdown of the exchange polarization model was found. (auth)

30818 SLOW NEUTRON SCATTERING BY MOLECULAR HYDROGEN AND DEUTERIUM. James A. Young and Juan U. Koppel (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Phys. Rev., 135: A603-11 (Aug. 3, 1964).

The cross sections for neutrons scattering from H_2 and D_2 were calculated taking into account the spin correlations, rotations, and vibrations of the molecules exactly, to the extent that the vibrations are harmonic and do not interact with the rotations. Free translations of the molecules are assumed, but this assumption is expected to be valid in the liquid, as well as the gas, for neutron energies above 0.007 ev, the Debye temperature for hydrogen. Numerical results are given for the total cross section for both orthohydrogen and parahydrogen gas at 20.4°K which agree reasonably well with the limited experimental results available. Also, curves of the double differential cross section are shown for selected incident neutron energies and scattering angles. These latter curves show very clearly the various rotational and vibrational transitions. The formulas given here are applicable at all temperatures

below the thermal excitation of the first vibrational level. (auth)

30819 VALIDITY OF THE CONCEPT OF THE CORE POLARIZATION EFFECT IN HYPERFINE STRUCTURE. E. A. Burke (St. John's Univ., Jamaica, N. Y.). Phys. Rev., 135: A621-6(Aug. 3, 1964).

The core polarization effect in hyperfine structure is discussed by a semiempirical evaluation of 16 recently calculated values of the Fermi contact term for the ground state of lithium. The analysis proceeds by an investigation of the manner in which the various wave functions approximate eigenfunctions of S^2, in conjunction with an examination of the one-electron orbitals employed. The concept of core polarization by non-s electrons is shown to be valid, while if the polarizing electron is an s electron, no definite conclusion concerning core polarization can be made. Finally, it is proposed that for all cases of a single polarizing electron, the many-electron, approximate unrestricted Hartree-Fock wave function may be used. Two tests of the validity of this wave-function approximation are proposed. (auth)

30820 β DECAY AND THE STRUCTURE OF H^3 AND He^3. R. J. Blin-Stoyle (Univ. of Sussex, Eng.). Phys. Rev. Letters, 13: 55-6(July 13, 1964).

It is shown by comparison of the ft values for the β decay of ^3H to ^3He and the neutron that the β decay serves as a sensitive test for the probability of inclusions of a $^2S_{\frac{1}{2}}$ state (S′) of mixed spatial symmetry, in addition to the dominant space-symmetric $^2S_{\frac{1}{2}}$ state (S) and the usual $^4D_{\frac{1}{2}}$ states (D). (L.B.S.)

30821 NUCLEAR OPTICAL MODEL FOR VIRTUAL PIONS. J. S. Bell (Stanford Univ., Calif.). Phys. Rev. Letters, 13: 57-9(July 13, 1964). (SLAC-PUB-32)

Cross sections for incident virtual pions are investigated using the optical model potential. The critical dependence of $\sigma(W,-q^2)$ on q^2 is discussed. (L.B.S.)

30822 VACUUM SCATTERING CHAMBER FOR INVESTIGATING REACTIONS WITH CHARGED PARTICLES. V. I. Lamunin, V. P. Rudakov, I. N. Serikov, N. I. Sokolov, and N. N. Khaldin. Pribory i Tekhn. Eksperim., No. 2, 61-3(Mar.-Apr. 1964). (In Russian)

A scattering chamber for investigating charged particle reactions with nuclei is described. Angular distributions can be measured for angles of 10 to 170°. The position of the detection apparatus, the target position, and target changing is handled by remote control. (tr-auth)

30823 ANALYSIS OF SOME ALLOWED BETA-TRANSITIONS. S. Swaranagowri and M. K. Ramaswamy (Karnatak Univ., Dharwar, India). Proc. Indian Acad. Sci., Sect. A, 59: 203-6(Apr. 1964).

Sakai's method of analyzing log ft values has been extended to higher excited states in even-even nuclei. Within the context of the rather limited data an enhancement in the matrix element is observed for transitions to $2''^+$, $2'''^+$, and $4'^+$ and $4''^+$ levels. (auth)

30824 NUCLEAR ELECTRON DOUBLE RESONANCE AT 12500 GAUSS. R. E. Richards and J. W. White (Oxford Univ.). Proc. Roy Soc. (London), Ser. A, 279: 481-9 (June 16, 1964).

Dynamic nuclear polarization experiments were performed on proton resonances at 43.2 Mc/s using a magnetic field of 12500 gauss and 8 mm microwave radiation. The nuclear polarization at infinite microwave power is equal to that expected for the extreme narrowing case, using measured values of the nuclear spin-lattice relaxation times. The rate at which the nuclear polarization is built up during the experiment is equal to the rate at which it decays due to spin-lattice relaxation. When the enhancements for infinite power are extrapolated to infinite radical concentration, the ratio of the signal strength before and after enhancement is close to −330, as expected for dipole coupling. For mobile organic liquids the case of extreme narrowing does seem to be reasonably applicable. (auth)

30825 THE (d,α) REACTION AND CLUSTER STRUCTURE OF LIGHT NUCLEI—THE $O^{16}(d,\alpha)N^{14}$ REACTION. Tsuyoshi Honda (Tohoku Univ., Sendai), Hisashi Horie, Yoshiteru Kudo, and Haruo Ui. Progr. Theoret. Phys. (Kyoto), 31: 424-33(Mar. 1964).

The $^{16}O(d,\alpha_0)^{14}N$ (ground state) and the $^{16}O(d,\alpha_2)^{14}N$ (2nd excited state) reactions are analyzed for energies from 14.5 to 19.6 Mev in terms of both the pickup and heavy-particle stripping reactions, without introducing any energy-dependent adjustable parameters. The cross section is calculated by formula derived previously under the cutoff Born approximation and by adopting the ratios of the reduced widths calculated from the harmonic oscillator shell model. The magnitudes of the reduced widths are determined from the experimental data. Good agreement is obtained concerning the overall behavior of the differential cross sections. In particular, the ratio of the cross sections leading to different states of the residual nucleus is reasonably accounted for by the analysis. (auth)

30826 COLLECTIVE EXCITATION OF UNLIKE PAIR STATES IN HEAVIER NUCLEI. Kiyomi Ikeda (Nihon Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), 31: 434-51(Mar. 1964).

The neutron hole-proton pair ($\tilde{n}-p$) correlations in heavier nuclei are studied on the basis of the j-j coupling shell model. It is shown that the even-parity states such as the coherent mixture of many unperturbed ($\tilde{n}-p$) states are pushed up by the ($\tilde{n}-p$) repulsive interactions with T = 1. The isobaric state $T_-|\psi_0\rangle$ can be interpreted as a coherent state with $J^\pi = 0^+$. The coherent states with non-zero spin arise in the high excited energy region, but not higher than that of the isobaric state. They may be strongly excited by the (p,n) reaction. Actual numerical calculations assuming zero-range forces are performed for the $J^\pi = 1^+$ states of the nucleus ^{208}Bi which can be produced by the (p,n) reaction using the target nucleus ^{208}Pb. (auth)

30827 ROTATIONAL BANDS IN IRON-56. Raj K. Gupta and P. C. Sood (Panjab Univ., Chandigarh, India). Progr. Theoret. Phys. (Kyoto), 31: 509-11(Mar. 1964).

The energy level structure of ^{56}Fe is discussed on the basis of the rotational model. Comparisons of experimental and rotational level schemes and of rotational constants indicate that rotational band structure for ^{56}Fe is meaningful. (D.C.W.)

30828 A NOTE ON SUM RULE IN THE MÖSSBAUER EFFECT. Isao Mannari (Shizuoka Univ., Japan). Progr. Theoret. Phys. (Kyoto), 31: 512-13(Mar. 1964).

The sum rule is formulated in the formalism of Singwi and Sjolander. (D.C.W.)

30829 MEASUREMENT OF THE FIRST EXCITED STATE OF F-19 BY THE DELAYED COINCIDENCE METHOD. M. Vazquez, C. Taguena, and V. C. de la Pena (Universidad Nacional de Mexico, Mexico City). Rev. Mex. Fis., 12: 27-41(1963). (In Spanish)

The lifetime of the first excited state of ^{19}F has been measured by delayed coincidences, using a 2-Mev Van de Graaff machine. The prompt coincidence curve was obtained with an ^{27}Al target. The ^{19}F target was prepared by evaporation of lead fluoride on tantalum backing. A ^{10}B target was also used to test and calibrate the equip-

ment. The lifetime of the first excited state of ^{10}B has been measured several times, these results agreeing satisfactorily. Therefore, the ^{10}B lifetime of 10^{-9} sec was used as a calibration standard for the time axis. The observed shift of the centroid of the delayed coincidence curve corresponds to this value. The ^{19}F targets were bombarded with 1.5-Mev protons and a shift corresponding to a lifetime of $(0.87 \pm 0.14) \times 10^{-9}$ sec was obtained. (auth)

30830 ASYMMETRIC EMISSION OF ELECTRONS IN Co-60. Juan Carlos Cervi (Private Inst. of Physical and Biophysical Investigations, Córdoba, Argentina). Rev. Real Acad. Cienc. Exact., Fis. Nat. Madrid, 57: 745-70 (1963). (In Spanish)

A brief critical analysis is made of Dirac's theory and of the present thought on weak interactions and on the true significance of the law of parity. This study is the basis of a new concept on the quantization of the electron's own energy, explaining physically the variation of the mass with the velocity of the corpuscles. Bohr's formula for the interaction of the fast corpuscles with matter is used to demonstrate the decrease of this interaction with velocity. It is shown that at velocities approaching the speed of light the electron is unstable and can break up into neutrinos, in the same manner as some cosmic particles. The apparent asymmetry of electrons in Lee's experiment is explained thus: the electrons emerge from Co-60 symmetrically but with different velocities. (auth)

30831 INVESTIGATIONS OF GAMMA RAYS FOLLOWING THE BETA DECAY OF Br^{82}. L. Simons, S. Bergstroem, and A. Anttila (Univ. of Helsinki). Soc. Sci. Fennica, Commentationes Phys.-Math., 29: 1-22(1963).

The gamma rays which follow the decay of ^{82}Br were investigated by means of NaI(Tl) scintillation spectrometers. A new energy level at 2430 kev was found. Six angular correlations were measured, of which four were not investigated earlier: 1042–777, 832–1042, 832–(1042)–777, and 617–700 kev. The correlations made it possible to exclude spin 3 for the 1821 kev level; thus 4^+ is assigned to this level. The M3 admixture in the 1042 kev transition and the M2 admixture in the 832 kev transition were found to be very small. The E2/M1 mixing parameters of the 617 and 700 kev gamma rays were determined as -2.6 ± 0.4 and -2.9 ± 1.8. The results are compared with predictions of theory. The E2 reduced transition probabilities led to a value of 27.3° for the non-axiality parameter γ. (auth)

30832 ON THE EQUILIBRIUM FORM OF LIGHT NUCLEI. B. I. Tishchenko, A. A. Kresnin, and A. V. Shebeko. Ukr. Fiz. Zh., 8: 1185-92(1963). (In Ukrainian)

The problem of the motion of nucleons in a nonaxial oscillator potential is considered within the confines of the generalized nucleus model, taking into account the spin-orbital interaction and the Nilsson interpolation term. The values of the one-particle energy levels of light nuclei with $A \leq 16$ were obtained, and the parameters of deformation β and γ were calculated for these nuclei. The question of the dependence of the deformation parameters on the change in the parameter of the spin-orbital interaction and Nilsson's parameter is considered. (auth)

30833 ON THE DETERMINATION OF ONE-PARTICLE WAVE FUNCTIONS FOR LIGHT NUCLEI. B. I. Tishchenko and A. A. Kresnin. Ukr. Fiz. Zh., 9: 233-41(Mar. 1964). (In Ukrainian)

Formulas are presented for finding one-particle energy levels and wave functions of nucleons moving in a deformed axisymmetrical potential, taking into account the interaction of the states with various values of the principal quantum number N. Formulas are obtained for the computation of the magnetic moment, the unbinding parameter, and the internal quadrupole moment. It is pointed out that the probability of electromagnetic transitions (type E2, for instance) between states with various N, forbidden if this interaction is neglected differs from zero. (auth)

30834 ON POLARIZATION EFFECTS IN THE HEAVY PARTICLE STRIPPING REACTION. Yan Tseipek. Ukr. Fiz. Zh., 9: 242-50(Mar. 1964). (In Ukrainian)

Angular distributions and polarizations of the products in the heavy particle stripping reaction with polarized deuterons and nuclei are considered. The state of polarization of the initial system is described by the density matrix developed in terms of the spin tensors and transformed to the density matrix of the final state. An auxiliary quantity is defined which allows the calculation of the mean values of the tensor operators describing the angular distribution and polarization states of the final particles at any given polarization of the initial particles. The results found by Robson are obtained as special cases. Formulas are deduced for the angular distribution of the protons released in the heavy particle stripping reaction on oriented nuclei and for the polarization of the final nuclei, the initial nuclei being unpolarized. (auth)

30835 ELASTIC AND INELASTIC SCATTERING OF NEUTRONS BY NUCLEI WITH ROTATIONAL AND VIBRATIONAL SPECTRA. V. S. Ol'khovskii and Yu. V. Tsekhmistrenko. Ukr. Fiz. Zh., 9: 251-9(Mar. 1964). (In Ukrainian)

The method of effective potentials was applied to the dynamical problem of elastic and inelastic scattering of neutrons with energies 0.5 to 3 Mev by nonspherical nuclei with a rotational spectrum and by spherical nuclei with a vibrational spectrum. Scattering which goes through the stage of formation of a compound nucleus was taken into account. The calculations, which were carried out by means of electronic computer M-20, show that the best agreement between the proposed model and the experimental data on the scattering of neutrons by nuclei of ^{12}C, ^{20}Ne, ^{24}Mg, ^{48}Ti, ^{56}Fe, ^{208}Pb, ^{232}Th, and ^{238}U is attained with the following values of the parameters: the depth of the real part of the potential = 50 Mev, the depth of the imaginary part = 1 Mev, and the nuclear radius $(1.22\sqrt[3]{A} + 0.74) \times 10^{-13}$ (A is the mass number of the element). (auth)

30836 SCATTERING OF NUCLEONS BY NUCLEI WITH SHELL PROPERTIES. V. S. Ol'khovskii. Ukr. Fiz. Zh., 9: 260-5(Mar. 1964). (In Ukrainian)

The method of effective potentials was used to investigate the dynamic problem of the elastic and inelastic scattering of nucleons by nuclei with shell properties. New expressions are obtained for the amplitudes of collisions with redistribution of particles and for exchange amplitudes. The matrix elements entering into the potential operators are calculated. The conclusion is drawn that the ordinary optical model describes sufficiently well the nonexchange elastic scattering of nucleons by nuclei with shell properties. (auth)

30837 PROTON SPECTRA FROM THE REACTION $He^4(d,np)He^4$. E. Ismatov. Ukr. Fiz. Zh., 9: 266-71(Mar. 1964). (In Ukrainian)

Deuteron splitting on scattering by ^4He nuclei is considered. The interactions of the neutron and proton with the nucleus and with each other in the finite state, as well as the nuclear recoil, were taken into consideration. A formula is obtained for the energetic and angular distributions

of protons with respect to the direction of the incident deuteron (E_d = 20.2 and 14.6 Mev). The computed values of the proton spectra were compared with the experimental data. (auth)

30838 ON THE THEORY OF BACK-SCATTERING OF MONOENERGETIC ELECTRONS. Hans-Wolf Thuemmel (Institut für Angewandte Radioaktivität, Leipzig). Z. Physik, 179: 116-47(1964). (In German)

The diffusion theory according to Bothe for back-scattering perpendicular to a target bombarded by monoenergetic electrons in the backward 2-π space was proved by introduction of the exact, energy-dependent parameters and considerations on the useability of the multiple reversal of electrons not contained in the statement of Bothe in back-scattering. It is shown that they are, in general, not in a position to describe the back-scattering energy distribution of monoenergetic electrons. Approximations for parameters of the theory as functions of the primary energy and order number were developed. The exit energy distribution was calculated. (M.C.G.)

30839 PHOTO-PAIR PRODUCTION OF WEAKLY INTERACTING CHARGED VECTOR BOSONS. William Williamson, Jr. Thesis, Boulder, Colo., Univ. of Colorado, 1963. 138p.

The total coherent cross section for producing pairs of semi-weakly interacting charged vector bosons, W^+ and W^-, by bombarding iron nuclei with photons in the several billion electron volt (Bev) energy range was calculated. The calculation takes into account those transitions in which the nucleus is not excited, either in intermediate virtual states or in the final state. The boson is characterized by its mass, its magnetic dipole moment, and an assumed possible electric dipole moment. The electric dipole moment, if different from zero, would violate parity invariance and time reversal invariance. The Coulomb field of the nucleus was modified in accord with the spatial distribution of electric charge as found in the elastic electron-nucleus scattering experiments. The calculation was carried out treating the incident photon energy, the boson mass, and its magnetic and electric dipole moments as variables. Numerical evaluation of the cross section, for photon energies presently available at high energy electron accelerators, was carried out on a high speed electronic computer. Considerable dependence of the cross section on the magnetic and electric dipole moments was found, and because of the fact that the ranges of the photon energy and of the boson mass were such that the production was not very far from threshold, there was, of course, very strong dependence on these two variables. The cross section for coherent photo-pair production of W^+ and W^- in the Coulomb field of a nucleus (photoproduction) was compared with the cross section for production of a single W^+ or W^- by a high energy neutrino collision with a nucleus (neutrino-production), and also with that for production of a single W^+ or W^- by a meson (π) collision with a proton (pion-production). If the mass of the W-boson, m_w, is about half of the proton, m_p, then the photoproduction process has a cross section about one hundred times that of the neutrino-production process. If m_w and m_p are about equal, the neutrino-production cross section is somewhat larger than that for photoproduction. If m_w is about three-fourths of m_p, then the cross section estimated for the pion-production process is probably somewhat larger than those for the other two processes, for equal incident particle energies. (auth)

30840 PERTURBED ANGULAR CORRELATIONS. Supplemented by Proceedings of The Uppsala Meeting on "Extranuclear Perturbations in Angular Correlations," May 27-30, 1963. E. Karlsson, E. Matthias, and K. Siegbahn, eds. Amsterdam, North-Holland Publishing Company, 1964. 482p. $12.60.

Thirty-nine papers on the measurement, evaluation, theory, and uses of perturbed gamma angular correlations are included. Separate abstracts were prepared for 29; 10 papers were previously abstracted in NSA (17: 26525, 29611, 34930, 41972; 18: 2868, 6182, 18945, 21276, 21321, 28738). (D.C.W.)

For abstracts of individual papers see: 30062, 30221, 30432, 30841, 30842, 30843, 30844, 30845, 30846, 30847, 30848, 30849, 30850, 30851, 30852, 30853, 30854, 30855, 30856, 30857, 30858, 30859, 30860, 30861, 30862, 30863, 30864, 30865, and 30866.

30841 THE INFLUENCE OF EXTRANUCLEAR FIELDS ON ANGULAR CORRELATIONS. Rolf M. Steffen (Purdue Univ., Lafayette, Ind.) and Hans Frauenfelder. p.1-89 of "Perturbed Angular Correlations." Amsterdam, North-Holland Publishing Co., 1964.

The basic aspects of the theory of extranuclear perturbations on angular correlations are reviewed, together with the main associated experiments. Determinations of the g-factors (some values are tabulated) of excited nuclear states and of the static quadrupole coupling by correlation measurements are considered separately, as is the effect of preceding decay processes on angular correlations. 199 references. (D.C.W.)

30842 MAGNETIC MOMENTS OF NUCLEAR EXCITED STATES. E. Bodenstedt (Universität, Bonn) and J. D. Rogers. p.91-151 of "Perturbed Angular Correlations." Amsterdam, North-Holland Publishing Co., 1964.

The uses of Mössbauer and angular correlation techniques, particularly the use of perturbed angular correlation techniques, to study nuclear magnetic moments are reviewed. The pertinent aspects of the theory of perturbed angular correlations are summarized; and experimental methods for determining g factors of excited nuclear states are considered, together with existing g values. The theoretical interpretation of magnetic moments is also briefly discussed. 167 references. (D.C.W.)

30843 NUCLEAR MAGNETIC DIPOLE MOMENTS AND ELECTRIC QUADRUPOLE MOMENTS. S. G. Nilsson (NORDITA, Copenhagen and Univ. of Lund, Sweden). p.163-81 of "Perturbed Angular Correlations." Amsterdam, North-Holland Publishing Co., 1964.

Theory for the electric and magnetic moments is discussed in relation to experimental observations, with emphasis on extreme-single-particle, pairing, and collective effects. (D.C.W.)

30844 NUCLEAR g-FACTORS OF THE FIRST EXCITED STATES IN Lu^{175} AND Tl^{203}. E. Karlsson, E. Matthias, S. Gustafsson, K. Johansson, A. G. Svensson, P. Da R. Andrade, and S. Ogaza (Univ. of Uppsala). p.182-5 of "Perturbed Angular Correlations." Amsterdam, North-Holland Publishing Co., 1964.

The g factors of the first excited states in ^{175}Lu and ^{203}Tl were determined by the integral angular correlation method, using a 4-channel coincidence arrangement in combination with a 60,000-gauss electromagnet. The values are given, together with that previously obtained for ^{177}Hf, and are compared with theoretical predictions. Interpretation of the values for ^{175}Lu and ^{177}Hf in terms of the strong-coupling collective model was also undertaken. (D.C.W.)

30845 MAGNETIC MOMENTS OF 5^- STATES IN Sn^{118} AND Sn^{120}. M. Deutsch, A. Buyrn, and L. Grodzins (Mas-

sachusetts Inst. of Tech., Cambridge). p.186-9 of "Perturbed Angular Correlations." Amsterdam, North-Holland Publishing Co., 1964.

The g factors of the 5^- states in ^{118}Sn and ^{120}Sn at 2.32 and 2.30 Mev, respectively, were determined by the precession of the gamma-gamma angular correlations both in external and internal magnetic fields. (D.C.W.)

30846 PULSED BEAM MEASUREMENTS OF THE GYROMAGNETIC RATIO OF THE 100 kev 2^+ STATE IN W^{182} AND OF THE 111 kev 2^+ STATE IN W^{184}. R. P. Scharenberg, J. Kurfess, G. Schilling, J. W. Tippie, and P. Wolfe (Case Inst. of Tech., Cleveland). p.190-9 of "Perturbed Angular Correlations." Amsterdam, North-Holland Publishing Co., 1964.

The g factors of 2^+ states obtained in ^{182}W and ^{184}W by Coulomb excitation with an nsec pulsed beam were determined by observation of the precession of the de-excitation gamma angular distribution in an external magnetic field. The mean lives of the excited states were determined by a least squares fitting of the observed decay. The results are tabulated, together with values obtained by other methods. (D.C.W.)

30847 MEASUREMENT OF THE g_R-FACTOR OF THE 2^+ ROTATIONAL LEVEL IN W^{184} H. J. Koerner, E. Gerdau, J. Heisenberg, and J. Braunsfurth (Universität, Hamburg). p.200-3 of "Perturbed Angular Correlations." Amsterdam, North-Holland Publishing Co., 1964.

The g factor of the 2^+ first excited state in ^{184}W was determined to be 0.283 ± 0.017 by measurements on the 793–111-kev, $2^+-2^+-0^+$ angular correlation in an external magnetic field, using a metallic source. Measurements with a liquid source showed attenuation of the angular correlation by internal fields and gave a value of 0.32 ± 0.04. The result obtained with the metallic source is preferred and gives a mean life of 1.79 ± 0.06 nsec. (D.C.W.)

30848 GYROMAGNETIC RATIO OF THE 206.3 kev STATE OF Re^{187}. H. K. Walter, A. Weitsch, and P. Kienle (Technische Hochschule, Munich). p.210-12 of "Perturbed Angular Correlations." Amsterdam, North-Holland Publishing Co., 1964.

The g factor of the 206.3-kev level of ^{187}Re was determined to be 1.11 ± 0.01 by observation of the precession of its spin in a magnetic field. The spin-precession was observed by a measurement of the time dependence of a γ-γ angular correlation pattern. The magnetic moments of the 206.3-kev and ground states of ^{187}Re can be explained in terms of the Nilsson model. Measurement of the delayed coincidence curve of the 479.4–72.0 kev cascade gave a half life of $5.70 \pm 0.05 \times 10^{-7}$ sec for the 206.3-kev level. (D.C.W.)

30849 MAGNETIC PROPERTIES OF THE K = 1/2 ROTATIONAL STATES IN Tm^{169}. F. Boehm, J. De Boer, and D. Bowman (California Inst. of Tech., Pasadena). p.213-16 of "Perturbed Angular Correlations." Amsterdam, North-Holland Publishing Co., 1964.

The B(M1) for the $\frac{5}{2} \rightarrow \frac{3}{2}$ and $\frac{7}{2} \rightarrow \frac{5}{2}$ transitions were determined from previous experimental data to be 0.125 ± 0.01 and 0.13 ± 0.04, respectively. Using relations between the magnetic moments of the $\frac{1}{2}$ and $\frac{3}{2}$ states together with the first of these values, the magnetic parameters b_0, g_K, and g_R were determined to be −0.16 ± 0.03, −1.57 ± 0.11, and 0.406 ± 0.019, respectively. The magnetic moments for the $\frac{5}{2}$ and $\frac{7}{2}$ states were then calculated to be 0.74 and 1.45, respectively. An angular correlation measurement of the magnetic moment for the $\frac{7}{2}$ state gave a preliminary result of 0.5 with an estimated error of ±50%. (D.C.W.)

30850 EFFECTS OF INTERNAL PERTURBATION ON g-FACTOR MEASUREMENTS. E. Bodenstedt (Universität, Bonn). p.217-27 of "Perturbed Angular Correlations." Amsterdam, North-Holland Publishing Co., 1964.

The effect of internal perturbation on g-factor measurements by the integral angular correlation method is outlined. The effects of finite time resolution, the Deutsch effect, correction for time-dependent attenuation, and the paramagnetic correction factor are also discussed. An observation of the spin-rotation of the 329–481-kev, γ-γ angular correlation in the decay of ^{140}La is reported. (D.C.W.)

30851 INFLUENCE OF ATOMIC FIELDS ON THE PRECESSION OF ANGULAR CORRELATIONS. Zeev Vager and G. Goldring (Weizmann Inst. of Science, Rehovoth, Israel). p.238-46 of "Perturbed Angular Correlations." Amsterdam, North-Holland Publishing Co., 1964.

It is shown that in some cases the influence of atomic fields on precession measurements in solids can be experimentally ascertained not to exceed certain limits. The conditions imposed on precession measurements by these limits are discussed, together with measurements of the g factors (tabulated) of 2^+ states of ^{182}W, ^{184}W, and ^{186}W. (D.C.W.)

30852 NUMERICAL TREATMENT OF THE THEORY OF PERTURBED ANGULAR CORRELATIONS. K. Alder (Univ. of Basel), E. Matthias, B. Olsen, W. Schneider, and R. M. Steffen. p.247-56 of "Perturbed Angular Correlations." Amsterdam, North-Holland Publishing Co., 1964.

The difficulties and limitations of a numerical treatment are discussed with particular reference to recent results of an investigation of the dependence of the attenuation factors on electric frequency distribution effects and on an axial symmetry of the electric field gradient. (D.C.W.)

30853 MEASUREMENTS OF COMBINED MAGNETIC AND ELECTRIC PERTURBATIONS IN POLYCRYSTALLINE SOURCES. E. Matthias, E. Karlsson, A. G. Svensson, K. Johansson, and P. Da R. Andrade (Univ. of Uppsala). p.257-63 of "Perturbed Angular Correlations." Amsterdam, North-Holland Publishing Co., 1964.

The effect of combined magnetic dipole and electric quadrupole interactions on an angular correlation were investigated using powder sources of hafnium metals and hafnium compounds (particularly $(NH_4)_3HfF_7$). Measurements were made on the 133–482 kev cascade in Ta using a 55,000-gauss magnet in connection with a four-channel coincidence system. The results are compared with theoretical predictions and other observations. (D.C.W.)

30854 A COMPARISON OF THE MÖSSBAUER AND THE ANGULAR CORRELATION METHODS FOR MEASURING NUCLEAR MOMENTS. Hans Frauenfelder (Univ. of Illinois, Urbana). p.278-88 of "Perturbed Angular Correlations." Amsterdam, North-Holland Publishing Co., 1964.

The principles, limitations, and merits of the Mössbauer and angular correlation techniques for studying nuclear quantities are discussed. The effects of external magnetic fields on angular correlations and Mössbauer effect and the information that can be obtained by the two methods are covered, together with their merits for determining nuclear structure, g factors, and quadrupole moments. (D.C.W.)

30855 MAGNETIC SHIELDING OF IMPURITY NUCLEI IN METALS: POSSIBLE EVIDENCE FOR EXCITED LOCALIZED STATES. N. Blum (Massachusetts Inst. of Tech., Cambridge), A. J. Freeman, and L. Grodzins. p.289-93 of "Perturbed Angular Correlations." Amsterdam, North-Holland Publishing Co., 1964.

Mössbauer measurements on 0.5% ^{57}Fe in antiferromagnetic chromium indicated that at temperatures below about 45°K, the ^{57}Fe nucleus is shielded from about 50% of the applied field, H_0, with $H_0 \leq 85$ kgauss. Also, a temperature-independent hyperfine field was observed with zero external field. The shielding constant is independent of applied field and temperature. The temperature-independent shielding is taken as evidence of a highly localized excited state near the Fermi energy. (D.C.W.)

30856 QUADRUPOLE MOMENTS OF THE FIRST 2^+ STATES OF W^{182} AND W^{184}. E. A. Phillips and L. Grodzins (Massachusetts Inst. of Tech., Cambridge). p.294-9 of "Perturbed Angular Correlations." Amsterdam, North-Holland Publishing Co., 1964.

The Mössbauer absorption spectra for W metal, WC, WS_2, WO_3, and $CaWO_4$ absorbers were obtained, and the quadrupole moment of the excited state was calculated. The observed line separations and field gradients are tabulated, and the internal field symmetry is discussed. Similarity of the absorption spectra of ^{183}W and ^{184}W obtained with a high-speed steel absorber (18% W) indicates that the excited-state quadrupole moments of the two isotopes differ by no more than 25%. (D.C.W.)

30857 g-FACTORS OF EXCITED STATES FROM THE PRECESSION OF THE MÖSSBAUER SCATTERED RADIATION IN A MAGNETIC FIELD. Paul H. Barrett (Massachusetts Inst. of Tech., Cambridge and Univ. of California, Santa Barbara). p.306-8 of "Perturbed Angular Correlations." Amsterdam, North-Holland Publishing Co., 1964.

A technique for measuring the magnetic moments of excited nuclear states is described that combines the techniques of angular correlation and Mössbauer scattering. (D.C.W.)

30858 MEASUREMENT OF THE INTERNAL MAGNETIC FIELD ACTING ON Ce^{140} NUCLEI SITUATED IN FERROMAGNETIC GADOLINIUM AND IN LANTHANUM AND CERIUM METAL. S. G. Cohen, N. Kaplan, and S. Ofer (Hebrew Univ., Jerusalem). p.313-15 of "Perturbed Angular Correlations." Amsterdam, North-Holland Publishing Co., 1964.

An attempt was made to measure the effective field acting on a Ce ion in Gd. The ion was found to become paramagnetic rather than remaining diamagnetic as desired. The field acting on Ce in Gd containing 2% La was, therefore, measured as a function of temperature. For temperatures of 120 to 300°K, negative fields approximately proportional to the magnetization of the Gd were observed; the field at 120°K was about −200000 gauss. An explanation is proposed. (D.C.W.)

30859 PRESENT STATUS OF ANGULAR CORRELATION RESEARCH IN RARE EARTH IRON GARNETS. M. E. Caspari and D. Ray (Univ. of Pennsylvania, Philadelphia). p.316-17 of "Perturbed Angular Correlations." Amsterdam, North-Holland Publishing Co., 1964.

Some measurements on the angular correlation of ^{152}Sm in Eu and Sm iron garnets and in Sm-substituted Lu and Y iron garnets are discussed in relation to theoretical predictions and each other. Experiments on ^{160}Dy in Tb iron garnet are also considered. (D.C.W.)

30860 RESONANCE BEHAVIOUR OF AN ANGULAR CORRELATION PERTURBED BY THE HYPERFINE INTERACTION. H. J. Leisi (Franklin Inst., Swarthmore, Penna.). p.318-21 of "Perturbed Angular Correlations." Amsterdam, North-Holland Publishing Co., 1964.

A simple description of resonant behavior due to interference effects is presented, together with an illustration of the resonant effect for the case of a 0-1-0 cascade perturbed by an isotopic fine interaction with electronic spin $\frac{1}{2}$ and an external magnetic field perpendicular to the detector plane. The information obtainable by observation of resonance peaks is indicated. (D.C.W.)

30861 DISCUSSION ABOUT AFTER-EFFECTS. p.329-36 of "Perturbed Angular Correlations." Amsterdam, North-Holland Publishing Co., 1964.

Evidence indicating that transitions (K capture, β decay, etc.) affect subsequent emissions (notably the angular correlations and polarization) is discussed, together with experimental detection of such effects. (D.C.W.)

30862 SUMMARY AND CONCLUSIONS. R. M. Steffen (Purdue Univ., Lafayette, Ind.). p.343-53 of "Perturbed Angular Correlations." Amsterdam, North-Holland Publishing Co., 1964.

The development of the experimental and theoretical understanding of perturbed angular correlations over the last twelve years is summarized. Future prospects are also indicated. (D.C.W.)

30863 PARAMAGNETIC EFFECTS. C. Guenther (Universität, Bonn) and I. Lindgren. p.357-75 of "Perturbed Angular Correlations." Amsterdam, North-Holland Publishing Co., 1964.

The change of the effective magnetic field at a nucleus in paramagnetic materials due to an external field is treated. A general formula for the increase of the effective field over the external field due to the unfilled electronic shell of the transition elements is derived. Paramagnetic correction factors calculated by the formula for all tripositive rare earth ions (Ce^{3+} – Yb^{3+}) at temperatures between 50 and 2000°K are tabulated, and the validity of the formula is discussed. (D.C.W.)

30864 TABLE OF NUCLEAR SPINS AND MOMENTS. I. Lindgren (Univ. of Uppsala). p.379-410 of "Perturbed Angular Correlations." Amsterdam, North-Holland Publishing Co., 1964.

The known spins and electromagnetic moments of nuclear excited and ground states are tabulated. Half lives for unstable states and excitation energies for excited states are included. 350 references. (D.C.W.)

30865 TABLE OF LIFETIME MEASUREMENTS OF EXCITED NUCLEAR STATES. J. Lindskog, T. Sundstroem, and P. Sparrman (Univ. of Uppsala). p.411-46 of "Perturbed Angular Correlations." Amsterdam, North-Holland Publishing Co., 1964.

Lifetime measurements are tabulated in order of increasing mass number. Level energies, half lives, reduced transition probabilities or level widths, and the multipolarities of the electromagnetic transitions deexciting the levels are included. The measurement methods are also indicated. 280 references. (D.C.W.)

30866 TABLE OF ANGULAR CORRELATION COEFFICIENTS. p.447-52 of "Perturbed Angular Correlations." Amsterdam, North-Holland Publishing Co., 1964.

A table of F coefficients taken from the tabulation of Ferentz and Rosenzweig (ANL-5324) is presented, and use of the coefficients is outlined. (D.C.W.)

30867 QUASI-ELASTIC p-p SCATTERING IN FLUORINE AND SOME "MEDIUM" NUCLEI. B. Gottschalk, K. Strauch, and K. H. Wang (Harvard Univ., Cambridge, Mass.). 6p. (CONF-35-4)

From American Physical Society New England Section 1963 Spring Meeting, Cambridge, Mass., Mar. 1963.

Quasi-elastic p-p scattering is studied at 42 and 50° in fluorine (using a KPF_6 target) and at 42° in the $1f_{1/2}$ nu-

clei ^{45}Sc, ^{51}V, ^{59}Co, and ^{58}Ni. The "distorted momentum distributions" of the target protons were measured by the "energy-sharing" technique. For fluorine the binding-energy (E_b) spectrum of the target proton exhibits three groups at 8, 12, and 19 Mev, which on the basis of their momentum distributions are identified as the 1s, $p^1/_2$, and $p^3/_2$ states, respectively. In the case of the medium nuclei the E_b spectra each have one predominant peak, and indicate that the residual nucleus is left in an excited state; the observed momentum distributions are intermediate in form between the 2s and $1d^5/_2$ distributions observed in the previous shell. (auth)

Plasma Physics and Thermonuclear Processes

Refer also to abstracts 29925, 30091, 30370, and 30375.

30868 (AD-427209) I. APPROXIMATE THEORETICAL CALCULATION OF CONTINUUM OPACITIES. II. RADIANT ENERGY EMISSION FROM ISOTHERMAL AND NON-ISOTHERMAL GASES. Technical Report No. 44. S. S. Penner and M. Thomas (California Inst. of Tech., Pasadena. Karman Lab. of Fluid Mechanics and Jet Propulsion). Nov. 1963. Contract Nonr-220(45), NR 015 401. 50p.

I. An approximate procedure is described for the theoretical calculation of the spectral absorption coefficient produced by bound-free and free-free transitions in plasmas containing polyelectronic atoms and ions. The method of calculation is based on the assumption that only two ionized species make important contributions to the opacity and that these two ionic constituents are present in equal concentrations. The approximate formulas are shown to yield results that are good accord with estimates based on detailed numerical computations. II. Three topics in radiation gas dynamics are considered. These are: (1) a specification of the relative importance of thermal conduction and radiation in heated air for the diffusion and transparent gas approximations; (2) an examination of the failure of the Eddington-Barbier approximation in radiative heat transfer for line radiation; and (3) some remarks on radiant energy transfer from nonisothermal air, particularly from heated air behind shock fronts. (auth)

30869 (AD-428783) ON THE QUASI-STATIC ANALYSIS OF WAVES IN A PLASMA-FILLED WAVEGUIDE. Report No. 63-22. J. E. Scharer and A. W. Trivelpiece (California. Univ., Berkeley. Electronics Research Lab.). Nov. 25, 1963. Contract AF19(628)-324. 27p.

The problem of determining the dispersion relations, electromagnetic field, and power flow in a cylindrical plasma-filled guide with a finite axial magnetic field is discussed. The quasistatic analysis used and the conditions for its validity are presented. The hybrid structure (coupled TE and TM modes with two eigenvalues) of the fields that is present in the exact analysis is brought out from an extension of the quasistatic analysis. It is shown that under certain conditions the dispersion relation and electromagnetic field derived from the quasistatic analysis agree with the exact solution even though the phase velocities for the wave modes are greater than the velocity of light. (auth)

30870 (AD-428797) THE DYNAMICAL EQUATIONS OF PARTIALLY IONIZED GASES. Gary D. Brinker (Cornell Univ., Ithaca, N. Y. Graduate School of Aerospace Engineering). Sept. 1963. 87p.

The dynamic equations for each component of a partially ionized monoatomic gas are presented in two forms. These formulations should be most useful in analyzing the effects of ionization in such nonequilibrium regions as plasma oscillation and boundary layers. Using a perturbed Maxwellian distribution to evaluate the collision integrals, the appropriate transfer equations for the multicomponent gas were given. These transfer equations simplify greatly when the gas is assumed to be very lightly ionized and are reduced to the equations of a single-fluid-with conduction model. Secondly, the equations for a three-fluid model are derived. In this model the properties of each species are defined in terms of its own motion, and not in terms of the total mass motion as in the one-fluid model. This model provides a useful physical interpretation of Joule heating effects. (auth)

30871 (AFCRL-63-199(Vol.1)) INVESTIGATION OF MICROWAVE COUPLING AND ENERGY PARTITION AND TRANSPORT WITHIN A PLASMA. CHAPTER I. FUNDAMENTAL CONCEPTS, TECHNIQUES, AND APPARATUS FOR THE MEASUREMENT OF GAS PROPAGATION CHARACTERISTICS AT HIGH MICROWAVE POWERS. Volume I. Final Report. Scientific Report No. 2. E. Rolfe, T. C. Athanis, C. Ferrar, R. Golub, S. P. Heims, L. H. Holway, C. Robinson, J. K. Silk, B. S. Tanenbaum, and A. Vernucci (Raytheon Co. Advanced Development Lab., Wayland, Mass.). Feb. 1963. Contract AF19(604)-7339. 323p. (AD-427693)

The theoretical and experimental research program concerned with plasmas, particularly with the mechanism of high-power microwave energy absorption and thermal energy transfer in a gas, the consequent heating of the unionized components of the gas, and the deionization and energy loss mechanisms involved is described. A detailed theoretical analysis of physical mechanisms governing the absorption of microwave radiation in gaseous plasmas is discussed, also two different methods of treatment used in the analysis of plasma behavior. Wave propagation through a plasma-filled waveguide section, and results of calculations performed are summarized. (auth)

30872 (AFCRL-63-376) STRUCTURE OF THE BOUNDARY LAYER IN A MAXWELLIAN PLASMA. Martin H. Millman and James Hurley (New York Univ., New York. Courant Inst. of Mathematical Sciences). Nov. 1963. Contract AF19(604)-3495. 9p. (EM-193; AD-427797)

The problem considered is that of the transition region separating a uniform maxwellian plasma from its confining magnetic field. The geometry chosen is one-dimensional. The magnetic field profile within the boundary layer is determined by the current distribution, i.e., by the path of the ions and electrons. The paths of these particles on the other hand are determined by the fields in which they move. The equation of motion of the ions is treated exactly and the electrons in the guiding center approximation. A self-consistent solution of Maxwell's equations is obtained. These results are compared with those obtained for a monoenergetic distribution and found to agree to within 10%. (auth)

30873 (AFCRL-63-577) EXCITATION OF PLASMA OSCILLATIONS BY SHOCK WAVES. Juergen-Dietrich Welly (Hanover (City). Technische Hochschule. Institut für Theoretische Physik). Sept. 1, 1963. Contract AF61 (052)-161. 55p. (AD-439209)

The velocity distribution of the electrons within a plasma shock front is investigated by methods of the kinetic theory arranged in a manner to account for heavy deviations from thermodynamic equilibrium. The distribution function ex-

hibits two peaks and becomes unstable with respect to electron oscillations, the shock wave being sufficiently strong (Mach number M ≳ 6.5). The second peak is formed by runaway electrons, i.e., those fast electrons that transgress the shock front from the hot region. The frequencies, wave numbers, grow rates, phase and group velocities of the excited oscillations, and the influence of the ohmic damping are calculated approximatively. The results are applied to the nonthermal radio-frequency radiation of the sun. (auth)

30874 (AFCRL-63-658) DYNAMIC NON-LINEAR WAVE PROPAGATION IN IONIZED MEDIA. 9. A NON-LINEAR COUPLING MECHANISM FOR GENERATION OF VERY LOW FREQUENCY WAVES. K. H. B. Wilhelmsson (Chalmers Tekniska Hogskola, Goteborg. Forskningslaboratorium for Elektronik). 1963. Contract AF61(052)-451. 21p. (AD-415427)

The generation of mixed-frequency fields by interaction of a longitudinal space-charge wave, carried by an electron stream through a plasma, and an electromagnetic wave (or a gyro-wave) is studied. The direction of propagation of the interacting waves, of different frequencies, is assumed to coincide with that of a static magnetic field. It is demonstrated that the generated difference-frequency field may propagate as an electron gyro-wave or possibly as an ion gyro-wave or even hydromagnetic wave, if the difference-frequency is sufficiently small and the effect of collisions negligible. The investigation is limited to the case of an infinitely extended homogeneous medium. (auth)

30875 (AFCRL-63-695) DYNAMIC NON-LINEAR WAVE PROPAGATION IN IONIZED MEDIA. 4. NON-LINEAR ELECTROMAGNETIC WAVE PROPAGATION AND HARMONIC RADIATION IN MAGNETO-IONIC MEDIA. Research Report No. 30. O. E. H. Rydbeck (Chalmers Tekniska Högskola, Göteborg. Forskningslaboratorium for Elektronik). Mar. 1, 1963. Contract AF61(052)-451. 36p. (AD-415440)

Nonlinear propagation studies are extended to a magnetoionic medium; the limitation being that all wave normals are assumed to be parallel. The general theory, involving arbitrary wave normals, will be dealt with in a forthcoming report. It is shown that, as expected, traveling wave resonances occur in the magnetoionic medium, not only between waves of the same kind (e.g., between waves of ordinary polarization), but equally frequent between waves of opposite kinds. From the nonlinear interaction point of view there, thus, is not much difference, at least in principle, between the ordinary and extraordinary waves. It is also found that the second order nonlinear waves are characterized by two different kinds of polarization which become equal only at traveling wave resonance. (auth)

30876 (AFCRL-63-782(Vol.I)) INVESTIGATION OF MAGNETOHYDRODYNAMIC WAVES. VOLUME I. SUMMARY. Final Report. C. D. Joerger (McDonnell Aircraft Corp., St. Louis). Nov. 30, 1963. Contract AF19(628)-239. 40p. (AD-429152; A-219(Vol.I))

The investigation by theory and experiment of the pertinent factors influencing the creation, propagation, and detection of a type of magnetohydrodynamic wave, and the Alfven wave, in a partially ionized, low-density medium is discussed. The theoretical aspects of MHD waves generated under ionospheric conditions, and their corresponding excitation in a simulated environment are investigated in Volume II. The experimental design is reported and subsequent test results of wave propagation in three plasma facilities; a hypervelocity impulse tunnel, an electromagnetic shock tube, and an arc discharge tube are given in Volume III. The report summarizes the results of the experimental program and outlines the theoretical work performed in support of the experiments. (auth)

30877 (AFCRL-63-782(Vol.II)) INVESTIGATION OF MAGNETOHYDRODYNAMIC WAVES. VOLUME II. THEORY. Final Report. C. D. Joerger (McDonnell Aircraft Corp., St. Louis). Nov. 30, 1963. Contract AF19(628)-2[illegible] 175p. (AD-429153; A-219(Vol.II))

The investigation by theory and experiment of the pertinent factors influencing the creation, propagation, and detection of a type of magnetohydrodynamic wave, the Alfven wave, that could exist in a partially ionized, low-density medium is discussed. The theoretical aspects of magnetohydrodynamic waves, as might be generated under ionospheric conditions and excited in a simulated environment are investigated in Volume II. Experimental design and subsequent test results of wave propagation in three McDonnell plasma facilities, are reported in Volume III. Volume I of this series provides the reader with a brief summary of Volumes II and III. (auth)

30878 (AFCRL-64-219) MICROWAVE INVESTIGATION OF THE DIELECTRIC WAVEGUIDE PROPAGATION BY MAGNETO-IONIC DUCTS. Technical Final Report, October 1, 1958–December 31, 1962. A. Gilardini (Selenia S.p.A., Rome). Oct. 1963. Contract AF61(052)-145. 87p (AD-439213)

Theoretical work includes discussion of the basic quasi-static and exact theories for propagation along plasma slabs and columns in magnetic fields, derivation of Brillouin diagrams, calculations of electromagnetic power flows, extension of theory to the case of external metallic walls, comparison with whistler-type characteristics, and approximate evaluations of propagation features in nonuniform and warm plasma slabs. Experimental work includes detection of plasma guided signals, measurements of their amplitudes, phase and group velocities, and measurements of the electron density. Most of the experimental results are interpreted in terms of the discussed theory. (auth)

30879 (ARL-64-111) INTERACTION OF FAST CHARGED PARTICLES WITH A PLASMA. Martin D. Altschuler (Yale Univ., New Haven. Observatory). July 1964. Contract AF33(657)-7271. 242p.

The hydromagnetic equations are solved for the electrostatic field distribution of a charged test particle in a plasma. When electrons are accelerated by the electrostatic field of the test particle they emit electromagnetic radiation. The spectrum of this radiation is calculated. When the test particle moves slower than the thermal electron speed, the electrostatic field of the test particle is a shielded and distorted Coulomb potential (i.e., a distorted Debye potential). The resulting electromagnetic radiation has a spectrum that agrees in the low- and high-frequency limits with the results of other researchers. When the test particle moves faster than the thermal electron speed, the plasma perturbations are contained within a Mach cone trailing the test particle. The resulting electromagnetic radiation has a resonance at $\omega_e[1 - V^2/u^2]^{-\frac{1}{2}} > \omega_e$ where ω_e is the plasma frequency and V and u are the thermal electron speed and test particle speed, respectively. When two or more test particles move together supersonically through the plasma, even harmonics of the resonant frequency arise in a natural manner. Possible applications of this theory to nonthermal radio emission of solar bursts are pointed out. (auth)

30880 (AROD-3420.8) INTERACTION OF MICROWAVES IN A PLASMA. Edward A. Desloge (Florida State Univ., Tallahassee). [1964]. 34p.

Progress in theoretical studies of the interaction of electromagnetic waves in a plasma is reported. A list of publications for the report period is given. Separate abstracts were prepared for the three complete papers included. (R.E.U.)

For abstracts of individual papers see: 30301, 30302, and 30881.

30881 (AROD-3420.8(Paper 3)) THE CONDUCTIVITY OF AN IONIZED GAS. Edward A. Desloge (Florida State Univ., Tallahassee). 39p.

An approximate solution to the Boltzmann transport equation for an ionized gas in an alternating electric field is obtained by expanding the electron distribution function in Laguerre polynomials. The general approach is similar to that used by others, however, the specific techniques employed result in an appreciable simplification of the conceptual and analytical detail of earlier work. In addition a simple expression for the conductivity is pointed out that is valid for all degrees of ionization and displays the dependence of the conductivity on the degree of ionization, the various cross sections involved, and the frequency of the applied field in a particularly tractable form. This expression agrees quite well over a broad range of cross sections with the results obtained by a more detailed analysis. (auth)

30882 (CONF-471-29) COLLISIONAL EFFECTS IN A HOT PLASMA AT ION-GYRO FREQUENCY. Ram K. Varma and Dilip Bhadra (California. Univ., La Jolla). [1963]. Contract AT(11-1)-34. 6p.

From American Physical Society 5th Annual Meeting, San Diego, Calif., Nov. 1963.

The effects of ion-ion collisions on the critical drift velocity of waves propagating near the ion gyro-frequency were investigated. A collision term is included in the ion Boltzmann equation. (R.E.U.)

30883 (CONF-471-30) COLLISIONAL DAMPING OF ION WAVES IN A PLASMA. Dilip Bhadra and Ram K. Varma (California. Univ., La Jolla). [196?]. Contract AT(11-1)-34. 7p.

From American Physical Society 5th Annual Meeting, San Diego, Calif., Nov. 1963.

An ionic sound wave in a plasma suffers attenuation even in the absence of collisions through Landau damping. The presence of collisions is generally considered to have a disrupting influence on the coherent wave propagation and should therefore give rise to a further damping of the waves. On the other hand, an ordinary sound wave is transmitted practically undamped through a dense gas in the presence of molecular collisions of extremely high frequency. In fact Landau damping of the sound waves would arise if the collision frequency is described from this high limit. Investigation of how the damping of the ion-waves in a plasma is affected by the presence of collisions, how the collisional damping would add on to the Landau damping, and how this undamping of the waves takes place as the collision frequency tends to infinity is presented. (auth)

30884 (JEN-129-DF/I-40) COMPORTAMIENTO EXPERIMENTAL DE UN PLASMA DE ARGÓN EN DIFERENTES CONFIGURACIONES DE CAMPO MAGNETICO Y A ELEVADAS CORRIENTES. (Experimental Behavior of an Argon Plasma, which is Passed by a High Current Intensity, with Different Magnetic Field Configurations). J. Lozano (Spain. Junta de Energia Nuclear, Madrid). 1964. 35p.

The longitudinal and azimuthal magnetic fields produced by the current through the tube and the returning conductors in a linear discharge were determined with a magnetic probe, which has a radial and longitudinal displacement. The plasma was produced by discharging a 135-μf—9-kv capacitor bank through argon at 0.1 torr. The effects of magnetic fields produced by currents in the returning conductors were studied. (auth)

30885 (JÜL-157-PP) TEILCHENBESCHLEUNIGUNG IN ZEITLICH LINEAR VERANDERLICHEN AXIALEN MAGNETFELDERN UNTER DER EINWIRKUNG ELEKTRISCHER RAUMLADUNGSFELDER. (Particle Acceleration in Transient Linear Variable Axial Magnetic Field Under the Effect of Electric Space Charge Field). H. Kever (Kernforschungsanlage. Institut für Plasmaphysik, Jülich, Germany and European Atomic Energy Community). Mar. 1964. 22p.

The motion of electrons in transient linear variable axial magnetic fields was investigated with consideration of the space charge field. The electron is considered to be free of collisions with the neutral gas. It is assumed that the charge density is so large that the motion of the electrons can be considered to occur in a quasi-neutral plasma. The depth of penetration of the magnetic field which is inversely proportional to the square root of the electron density is much deeper than the initial radius of the plasma. Under these assumptions the motion of electrons was calculated in the approximation given by the two-fluid theory of collision-free plasmas. (J.S.R.)

30886 (LAMS-3085) SEMIANNUAL STATUS REPORT OF THE LASL CONTROLLED THERMONUCLEAR RESEARCH PROGRAM FOR PERIOD ENDING APRIL 20, 1964. (Los Alamos Scientific Lab., N. Mex.). May 1964. Contract W-7405-eng-36. 78p.

Studies are reported on: E × B plasma heating in minimum-B configurations; the Mark III Stuffed Cusp experiment; high-density pinches; emission of cyclotron harmonics by PIG discharges; Scylla IV design and operations; transverse injection experiments; development of hydromagnetic plasma guns; and component development. (T.F.H.)

For an abstract of the individual item see: 30887.

30887 (LAMS-3085(p.5-16)) 1965-1966 PROGRAM FOR SHERWOOD RESEARCH AT LOS ALAMOS. J. L. Tuck (Los Alamos Scientific Lab., N. Mex.).

A projection is presented of the trends expected in Sherwood Project through 1966. Containment and injection philosophies and modes of operation (i.e., pulsed vs. steady-state) are included. (T.F.H.)

30888 (NP-14067) ELECTRON COLLISIONS IN NEON PLASMA. C. L. Chen (Illinois. Univ., Urbana. Coordinated Science Lab.). Apr. 1964. Contract DA-36-039-AMC-02208(E). 23p. (R-201)

The momentum transfer collision frequencies of electrons with neon ions and neutral atoms were measured in a decaying neon plasma for 200 to 600°K. The temperature-density dependence of the electron-ion collision frequency is determined to be $\nu_{ei} = 3.6\ (n/T_e^{3/2})\ \ln\ (2.0 \times 10^4\ T_e^{3/2}/n^{1/2})$. The energy dependence of the momentum transfer cross sections of electrons with neon atoms is best represented by $Q_{m_1}(U) = 2.55 \times 10^{-16}\ u^{1/2}$ and $Q_{m_2}(U) = 1.07 \times 10^{-17} + 2.17 \times 10^{-16}\ u^{1/2}\ cm^2$ for one- and two-term approximations, where u is the electron energy in electron volts. (auth)

30889 (NP-14082) STRUCTURE OF A PLASMA SHOCK WAVE. Fluid Mechanics Laboratory Publication No. 64-4. Michel Y. Jaffrin and Ronald F. Probstein (Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering). May 1964. Contract Nonr-1841 (93). 63p.

The one-dimensional, steady-state structure of a shock wave in a fully ionized plasma is investigated in the absence of external applied magnetic or electric fields. The structure is assumed to be described by the Navier-Stokes equations written for the electron and ion fluids, together with Poisson's equation for the self-induced electric field. When the Debye length downstream of the shock (λ_{D_2}) is small compared to the ion-ion mean free path there (l_2), the plasma remains essentially neutral and the equations governing the charge separation and electric field can be uncoupled from the system. The remaining equations are reduced by a boundary layer type analysis, which uses the fact that different dissipative mechanisms are important over different length scales, and an integration in phase space is carried out. It is found that when the free stream Mach number M_1 is less than 1.12, the plasma behaves like a single fluid and there is only one shock layer whose thickness is proportional to l_2/ϵ, where ϵ is the square root of the electron to ion mass ratio. When $M_1 > 1.12$, an ion shock appears embedded in a wider electron thermal layer and the respective thicknesses are of order l_2 and l_2/ϵ. Within the ion shock the electric field and charge separation each show a single damped oscillation with an amplitude proportional, respectively, to λ_{D_2}/l_2 and $(\lambda_{D_2}/l_2)^2$. When the shock is strong, a precursor electric shock layer in which the electric field and the charge separation again show a single damped oscillation appears upstream at the beginning of the thermal layer. With λ_{D_2} and l_2 of the same order, the electrical effects interact directly with the flow in the two electric shock layers. The equations are simplified by the fact that the electrical gradients are reduced by the increased tendency towards charge neutrality. Calculations for $M_1 = 10$ show that in the embedded electric shock layer there is a relative excess of electrons of approximately 50 percent locally and that there are damped vestiges of ion oscillations present. (auth)

30890 (NP-14095) A KINETIC THEORY APPROACH TO ELECTROSTATIC PROBES. Fluid Mechanics Laboratory Publication No. 64-5. Eliahu Wasserstrom, C. H. Su, and Ronald F. Probstein (Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering). May 1964. Contract Nonr-1841(93). 72p.

A spherical electrostatic (Langmuir) probe in a slightly ionized plasma is studied from a kinetic theory point of view. The two sided distribution function method of Lees, which embodies the Mott-Smith approach, is used. The velocity space is divided into two regions along the straight cone tangent to the spherical probe, and different distribution functions are defined in the two regions. On satisfying the two relevant moments of the distribution function (continuity and number density flux) three simultaneous ordinary nonlinear differential equations, which are appropriate to all values of the Debye length, collision mean free path, and probe potential, are obtained for determining the ion and electron number densities, and the potential. These equations reduce to the usual linear flux equations when the mean free path is much shorter than the probe radius and the Debye length. The equations are first linearized and solved for the case of small probe potential. Explicit solutions are given for the current-voltage characteristics and the distributions of the number densities and the potential. The general case of arbitrary probe potential is also studied. Results for the characteristics and for the potential drop in the sheath are presented for some representative cases. Many of the results which are obtained do not appear in the original simplified Langmuir model. The modifications required to take into account the curvilinear orbits of the charged particles are discussed. (auth)

30891 (NYO-9371) WAVE MOTION IN A PLASMA BASED ON A FOKKER-PLANCK EQUATION. Alan Oppenheim (New York Univ., New York. Courant Inst. of Mathematical Sciences). Mar. 31, 1964. Contract AT(30-1)-1480. 90p. (MF-39)

An isotropic approximation to the Fokker-Planck collision operator (IFP model) was constructed for the purpose of studying the small-amplitude wave motion of an unbounded, fully ionized, neutral, two-component plasma in a steady applied magnetic field. The linearized Boltzmann's equations are solved with Maxwell's equations, and the dispersion relation is constructed. Because the isotropic Fokker-Planck operators describe a diffusion process in velocity space, while the previously considered Krook relaxation models do not, an infinite number of new Larmor resonance modes were found at arbitrary directions of propagation with respect to the applied magnetic field. The new resonances remain in the limit of long macroscopic wavelengths and small collision frequencies. At propagation parallel to the applied magnetic field, new resonances for wavelength large and small with respect to the mean free path were found. In other macroscopic ranges the Krook and IFP models give similar results. As a special example, the Faraday rotation formula for a particular collisional plasma is verified. (auth)

30892 (ORNL-P-3) EXPERIMENTS ON A LARGE-VOLUME ELECTRON-CYCLOTRON-HEATED PLASMA. W. B. Ard, M. C. Becker, R. A. Dandl, H. O. Eason, A. C. England, and G. M. Haas (Oak Ridge National Lab., Tenn.). [1963]. Contract W-7405-eng-26. 18p. (CONF-564-1)

For Presentation at Colloquim on Interaction Between Electromagnetic Waves and Plasma, Saclay, France, Sept. 1964.

The production of high-β large-volume plasma in the EPA facility is discussed. Continuous-wave microwave power at levels up to 50 kw is supplied by three four-cavity klystron amplifiers operating at 10.6 gc. The EPA has a 3-to-1 magnetic mirror ratio. Diagnostic techniques and results are discussed. Bremsstrahlung measurements were made for the hot-electron plasma operated at 25 kw. (R.E.U.)

30893 (PAN-501/VII) ALFVÉN WAVES IN INHOMOGENEOUS MAGNETIC FIELDS. Ryszard Gajewski (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw) and Friedwart Winterberg (Case Inst. of Tech., Cleveland). Mar. 1964. 26p.

A perfectly conducting, nonviscous fluid is assumed to be permeated by an inhomogeneous, time-independent external magnetic field. Propagation of small-amplitude hydromagnetic waves with the velocity vector satisfying $\operatorname{div} \underline{v} = 0$ is investigated in a curvilinear coordinate system in which the lines of the external magnetic field are chosen as coordinate lines. It is shown that, if the lines have no torsion and if the external magnetic field has a certain symmetry, such that the field intensity is independent of one of the curvilinear coordinates, there exist rigorous solutions of the linearized hydromagnetic equations describing waves which travel along the lines of the external magnetic field, with the velocity of the fluid motion directed everywhere along the binormal to the local magnetic line of force. The examples of magnetic fields of plane and axial symmetry are discussed. (auth)

30894 (TID-20726) THE USE OF ATOMIC BEAMS AS A PROBE FOR STUDYING LOW-DENSITY PLASMAS.

Quarterly Progress Report, May 31, 1964. (New York Univ., New York). June 10, 1964. Contract AT(30-1)-2397. 12p.

An experimental setup designed for the use of atomic beams as probes for analyzing plasmas is described. (T.F.H.)

30895 (TID-20755) ION BEAM-PLASMA INTERACTION. Progress Report. (Florida. Univ., Gainesville). June 1, 1964. Contract AT(40-1)-2783. 11p.

Interactions of plasma with ion streams, and subsequent excitation of the plasma by these interactions, are studied experimentally. (T.F.H.)

30896 (TRECOM-TR-63-73) RESEARCH ON THE VOLUME RECOMBINATION OF CESIUM IONS. Final Report, October 1, 1960–June 30, 1963. (Radio Corp. of America. RCA Labs., Princeton, N. J.). Nov. 1963. Contract DA44-177-TC-694(T). 25p. (AD-427812)

The feasibility of the ion beam method of measuring the recombination cross section of cesium ions is demonstrated. The atomic recombination cross section is less than or equal to 5×10^{-19} cm^2, while the molecular recombination cross section is less than or equal to 3×10^{-14} cm^2. (auth)

30897 (UCRL-6804) RADIATION DAMAGE PROBLEMS IN THE ASTRON DEVICE. Richard A. Heckman (California. Univ., Livermore. Lawrence Radiation Lab,). Mar. 9, 1962. Contract W-7405-eng-48. 14p.

Results are presented of a study made in the latter part of 1957 of the probable radiation damage to materials and components of the thermonuclear power device, the Astron, then in a proposed stage. The existing theory of the mechanism of radiation damage to materials is summarized. The relative importance of the various factors that cause radiation damage is qualitatively assessed. Charts show the levels of neutron and gamma dosages at which engineering materials undergo physical changes. Estimated dosages are given for various Astron components; and proposed materials, operating limits, and inherent problems are discussed. A proposal is made for an experimental program to supply information about radiation damage to materials and components where such information does not exist. (auth)

30898 (JPRS-25168) IZVESTIYA VUZOV: RADIOPHYSICS. Translation of Izvestiya Vysshikh Uchebnykh Zavedenii, Radiofizika, 7: No. 1, 1-188(Jan.-Feb. 1964). 284p. (OTS-64-31520)

A separate abstract was prepared for one of the 19 papers; 7 were previously included in NSA (18: 26721 through 26727). Those articles not abstracted for NSA are: a review of quantum paramagnetic amplifiers, precision measurement of 4-mm radioemission from the Moon and Sun, the detection of water in Venus'atmosphere, scattering of waves by a statistically uneven surface, theory of type M transverse interaction tube, analysis of processes in a multicavity magnetron, periodic motions in a system of automatic frequency phase control, trial numbers in solution of problems in the synthesis of discrete automata, absorption of cm radiowaves in atmosphere, line strength in M1 transitions in the hyperfine structure of atoms, and protective coatings for cells with alkali metal vapors. (R.E.U.)

For an abstract of the individual paper see: 30899.

30899 (JPRS-25168(p.86-97)) COMPLEX DIELECTRIC CONSTANT OF A MAGNETOACTIVE PLASMA AT LOW FREQUENCIES. S. B. Biragov. Translated from Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 7: No. 1, 59-66 (Jan.-Feb. 1964).

The kinetic equations for the distribution functions of the electrons and ions are solved in the linear approximation. The distribution functions are represented in the form of expansions in Sonin's polynomials. An estimate is made of the influence of ion-ion collisions on the complex dielectric constant of the plasma. It is shown that the ion-ion collisions are insignificant in a fully ionized plasma, and also in a weakly ionized plasma for a definite law of interaction with the molecules. (auth)

30900 NONEQUILIBRIUM IONIZATION DUE TO ELECTRON HEATING: I. THEORY. Jack L. Kerrebrock (Massachusetts Inst. of Tech., Cambridge). AIAA (Am. Inst. Aeron. Astronaut.) J., 2: 1072-80(June 1964).

A two-temperature conduction law is proposed which accounts for the variation of the electrical conductivity of a plasma due to joule heating of the electrons. The conduction law represents the behavior of the plasma over a wide range of conditions likely to be encountered in MHD generators and accelerators. It differs from the usual Ohm's law in that the current density is proportional to about the fifth power of the electrical field for a slightly ionized gas with electron temperature more than 10% greater than the gas temperature. The process of relaxation from an initial condition of thermal equilibrium to the final nonequilibrium condition is treated for a channel flow that represents conditions in an MHD generator. For a mixture of argon and potassium at 1 atm pressure and 2000°K, the relaxation length is about 1 m at a Mach number of unity if the electric field is held constant. The stability of the two-temperature plasma to wavelike disturbances of electron energy and concentration is treated by the classical perturbation technique. It is concluded that such disturbances will amplify at large Hall parameters. The exponentiating time may be less than 10^{-5} sec, so that the disturbances could grow very large in a time of the order of the fluid residence time in an MHD channel. (auth)

30901 NONEQUILIBRIUM IONIZATION DUE TO ELECTRON HEATING: II. EXPERIMENTS. Jack L. Kerrebrock and Myron A. Hoffman (Massachusetts Inst. of Tech., Cambridge). AIAA (Am. Inst. Aeron. Astronaut.) J., 2: 1080-7(June 1964).

An experimental study was conducted of nonequilibrium conductivity of mixtures of argon and potassium. A pure plasma is produced in thermal equilibrium at temperatures up to 2500°K by means of a steady-flow tantalum heat exchanger. Conductivity measurements made with probes between the electrodes indicate that the two-temperature conduction law proposed is valid for electron concentrations above about 10^{13} cm^{-3}. The effective energy loss factor depends on the size of the apparatus and was found to be 10 for the test sections used in these experiments. At lower electron concentrations, the theory is in error, probably because the electron energy distribution is very non-Maxwellian. In this region, the electric field goes through a maximum with increasing current density, suggesting that it may be difficult to make the transition to the higher electron density nonequilibrium state from the initial low electron density equilibrium state in an MHD generator. (auth)

30902 SPECIFIC HEAT OF A DEGENERATE ELECTRON GAS. B. W. Ninham (Univ. of New South Wales, Kensington, Australia). Ann. Phys. (N. Y.), 28: 220-4 (June 22, 1964).

Computational errors in a calculation of the specific

heat of a degenerate electron gas as computed by Du Bois are corrected. (auth)

30903 ANALOGOUS PROPAGATION MODES IN INHOMOGENEOUS PLASMA AND TAPERED WAVEGUIDE. Herbert Laskinsky (Princeton Univ., N. J.). IEEE (Inst. Elec. Electron. Engrs.), Trans. Microwave Theory Tech., MTT-12; No. 2, 2p.(Mar. 1964). (MATT-237)

An analogy between the propagation of transverse electromagnetic waves in a plasma with no magnetic field and in a conventional waveguide is examined. The possibility of simulating certain properties of inhomogeneous plasma by use of waveguides with varying cross sections is analyzed. (D.C.W.)

30904 THE INTERACTION OF ELECTROMAGNETIC WAVES IN A PLASMA. S. C. Bloch and E. A. Desloge (Florida State Univ., Tallahassee). J. Atmospheric Terrest. Phys., 24: 1011-16(1962).

It is known that when two electromagnetic waves are simultaneously propagated through a plasma, an interaction takes place. An elementary analysis of this effect in the absence of a magnetic field is presented; mean-free-path or relaxation-time techniques are not used. The results bring out clearly the nature of the interaction and allow it to be discussed simply for arbitrary electron scattering cross section. (auth)

30905 ON THE PLASMA SHEATH. Louis Gold (Kennecott Copper Corp., Lexington, Mass.). J. Electron. Control (1), 16: 493-6(May 1964).

A formalism has been devised for dealing with the vexatious boundary-valued, one-dimensional sheath problem which admits series solutions that automatically yield the Bohm stability criterion. An advantage of the present theory is the embodiment of natural boundary conditions associated with the region in which the sheath and ambient plasma potentials merge. In this manner the much criticized and dimly perceived Bohm sheath criterion becomes clearer and is recognized to be the low energy limit for the sheath formation. Relativistic modification of the criterion for high-energy plasmas is indicated. (auth)

30906 LANGMUIR PROBE RESPONSE TO PERIODIC WAVEFORMS. F. W. Crawford and R. F. Mlodnosky (Stanford Univ., Calif.). J. Geophys. Res., 69: 2765-73 (July 1, 1964).

Research on dynamic probe techniques of plasma diagnostics is summarized and is extended by an analysis of an a-c method of determining electron density and temperature. The new method depends on the measurement of probe admittance and should have useful applications to ionospheric probing by rockets and satellites. Details of an illustrative example are given. Some of the implications of the theory presented bear on the accuracy of probe measurements of electron velocity distributions made by second derivative methods. These errors are discussed briefly. (auth)

30907 ION-ELECTRON TEMPERATURE RELAXATION IN A PLASMA IN A MAGNETIC FIELD. Yukikazu Itikawa (Tokyo Univ.). J. Phys. Soc. Japan, 19: 748-51 (May 1964).

The relaxation between ion and electron temperatures in a plasma in a magnetic field is investigated in a unified (wave and collision) theory without any cut-off procedures. The relaxation rate increases with the magnetic field. A general formula for the effect of the magnetic field on the rate is obtained, and some limiting cases are treated analytically. (auth)

30908 INFLUENCE OF A TRANSVERSE MAGNETIC FIELD ON THE SPECTRAL LINES FROM SHOCK-IONIZED GASES. Haruo Takeyama and Toshiatsu Oda (Hiroshima Univ.). J. Phys. Soc. Japan, 19: 763-4(May 1964).

The time-resolved relative intensities of the spectral lines from hydrogen and ionized argon behind shock fronts in a transverse magnetic field were measured by a photoelectric method. The intensities, luminosities, and rise times indicated that the plasma flows were not compressed toward the shock tube wall by the magnetic field. (D.C.W.)

30909 ON THE EXPERIMENT OF CUSP INJECTION. Hiroshi Itô, Tsutomu Ishimura, Kimiyuki Nishiguchi, Keiichi Hirano, Atsuhiko Ozaki, Kunizô Shinano, and Shigeko Takahashi (Osaka Univ.). J. Phys. Soc. Japan, 19: 773-4 (May 1964).

The injection of plasma into a biconical cusp device by a pinch plasma gun that gave velocities of 10^7 to 10^8 cm/sec was followed by magnetic probes and streak and Kerr cell photography. The axial velocity of the plasma decreased upon approaching the entrance cusp; but after entrance returned to its original value, with which it proceeded through the zero field region. The plasma became quiescent and stable about 10 μsec after injection. From spectroscopic data, the plasma density inside the cusp was estimated to be $5-7 \times 10^{15}$ cm^{-3}. (D.C.W.)

30910 PLASMA ACCELERATION BY THE RADIATION PRESSURE. Yasuo Suzuki, Hiroshi Ishizuka, and Goro Miyamoto (Tokyo Univ.). J. Phys. Soc. Japan, 19: 779(May 1964).

Plasma was injected into a waveguide (TE_{10} mode) and accelerated by the reflection of a microwave from the plasma bunch. The acceleration was greater at lower densities. (D.C.W.)

30911 INFLUENCE OF TRANSVERSE MAGNETIC FIELD ON PLASMA IN A RADIAL DISCHARGE TUBE. Toshiatsu Oda, Utaro Furukane, and Mitugi Hasikuni (Hiroshima Univ.). J. Sci. Hiroshima Univ., Ser. A-II, 27: 33-8(Mar. 1964).

The charged particle densities, temperatures, and electric field strength of plasma in a radial discharge tube placed in an axial external magnetic field are calculated from the transport equations. The calculations are performed on a coaxial thin layer in the positive column. It is shown that electron density has a maximum at a certain magnetic field strength and that the ion temperature increases strongly with the applied magnetic field strength. (auth)

30912 SPECTRA FROM PLASMAS PRODUCED BY MAGNETICALLY DRIVEN SHOCK WAVES. Toshiatsu Oda (Hiroshima Univ.). J. Sci. Hiroshima Univ., Ser. A-II, 27: 55-60(Mar. 1964).

Space-resolved spectra of plasmas produced by magnetically driven shock waves in H and Ar were investigated. A quartz shock tube, 2.2 cm in diameter and 30 cm in length, was used. Ar II lines do not appear within a distance of 3 cm from the discharge arc because of high temperature (≥2.6 ev), but become recognizable at 3 cm from the arc and last to the middle of the shock tube. Measurements of the shock velocity of the Ar plasma indicate a temperature of 1.2 ev and an ion density of 10^{17} cm^{-3} at 13 cm from the arc. Ar III lines are observed even in the arc region. Neither the H_β nor H_γ line appears at the arc. The spectra also contain Si lines due to the material of the shock tube wall and metallic lines due to the electrodes. At the arc region Si II and Si III lines are quite prominent and broadened. (auth)

30913 COLLECTION OF CHARGED PARTICLES ON PROBE IN HIGH PRESSURE PLASMA. Takayoshi Okuda. Mem. Fac. Eng., Nagoya Univ., 15: 122-34(May 1963).

The collection of charged particles on a probe immersed in plasma was investigated experimentally and theoretically. The depletion of charged particles was characteristic in high-pressure plasmas in which the mean free path of charged particles was small compared to the probe radius. The mechanism responsible for the depletion was that the density in the vicinity of the probe was decreased by virtue of scattering, according to a simple theory. However, to obtain a reasonable explanation for the observed depletion, a consideration of another process leading to an additional depletion was needed in addition to the simple theory. The former process is the formation of a disturbed region. The existence of a space charge sheath resulted in a reduction of the depletion. (auth)

30914 RESPONSE OF DRIFTING PLASMA TO DENSITY PERTURBATION. Takayoshi Okuda and Kenzo Yamamoto. Mem. Fac. Eng., Nagoya Univ., 15: 135-48 (May 1963).

Various tentative formulas for impedance of a drifting plasma were derived as a function of plasma parameters with help of the transport equation. An unsteady approach was applicable only for special cases where either density or velocity perturbation was considered or the inertia effect was disregarded. On the other hand, a quasi-steady approach had an advantage that both perturbations and deviation from space charge neutrality were involved. The results revealed that the resistive component is always positive, while the inductive one changes the polarity depending on the plasma density and the angular frequency. (auth)

30915 THE ROAD TO THERMONUCLEAR POWER. Peter Stubbs. New Scientist, 22: 680-2(June 11, 1964).

Research on magnetic wells, cusps, bottles, and pinches for controlled nuclear fusion is described. (auth)

30916 PROPOSED METHOD FOR THE PRODUCTION OF A MAGNETICALLY CONFINED HOT, DENSE PLASMA. A. W. Ehler (Hughes Research Labs., Malibu, Calif.). Nucl. Instr. Methods, 26: 238-42(Mar. 1964).

A method for dissociating high energy H_2^+ ions injected into a magnetic mirror container is proposed. The dissociating medium is a highly ionized plasma consisting of relativistic electrons and cold protons. Electrons emitted in the decay of unstable ^6He introduced into the mirror region will be trapped by the magnetic field. The dissociating plasma is accumulated by a continuous flow of ^6He through the mirror region for several minutes. Then the plasma is scrubbed by a flow of hydrogen and finally compressed magnetically to a density of about $2.5 \times 10^{11}/cm^3$. The resulting plasma provides an efficient dissociating medium for the injected H_2^+ ions while charge exchange losses of the trapped high energy protons are reduced to a minimum. (auth)

30917 INTRINSIC REGIMES OF PLASMA INSTABILITY AND THE ONSET OF ELECTROSTATIC OSCILLATIONS. L. Gold (Kennecott Copper Corp., Lexington, Mass.). Nuovo Cimento (10), 32: 1392-1404(June 1, 1964).

A criterion for the development of electrostatic space-charge oscillations is investigated for a wide variety of physical systems involving plasmas. The instability associated with the occurrence of such plasma oscillations is characterized for typical solid-state plasmas in metals and semiconductors as well as for actual gaseous plasmas in the form of astrophysical bodies and laboratory gas discharges. The principal effort required for this sort of undertaking entails the evaluation of the carrier density and the dominant relaxation mechanism that control the onset of these oscillations. Thus, certain temperature functionals arise whose meaning must be appraised. The possibility of an optimal temperature range so emerges, providing a novel explanation of well-defined regions of a-c output for plasma thermionic energy converters. The presence of spatial gradients in particle density and temperature in the interior of stars is shown to lead to a zonal instability, i.e., on passage outward from the thermonuclear core to the outer surface, the critical condition for the growth of plasma oscillations may be fulfilled over a limited region. The present-day conditions for laboratory thermonuclear plasmas turn out to be unstable; a closer look at high-density plasmas appears in order. Future refinement of the treatment of the relaxation processes may particularly take into account subtleties in the scattering of charged particles; the limiting behavior for Coulomb and screened potentials reveals essential differences. The well-known Onsager-Kirkwood criterion for ionized media may be viewed as a special case of the general criterion and is basically a stability criterion appropriate for plasmas where the relaxation derives from the screening of charges as in the Debye-Hückel theory. A number of other interesting items are briefly touched upon as the possible entry of the stability question in line-profile behavior under the influence of local electrostatic fields. (auth)

30918 LANDAU DAMPING AND FINITE-LENGTH EFFECTS IN UNIVERSAL PLASMA INSTABILITIES. Herbert Lashinsky (Princeton Univ., N. J.). Phys. Rev. Letters, 13: 47-50(July 13, 1964).

Experimental results of the proposed stabilization of the universal instability by ion Landau damping in a plasma whose dimensions satisfy the length-to-radius criterion $L/R \leq 10$ are reported. The effect of plasma length on the real part of the oscillation frequency was observed. Nonlinear effects were also observed at "quasilinear" amplitudes: "mode jumping" caused by the nonlinear transfer of energy from dampened modes to undampened modes, and "mode locking" attributed to nonlinear interactions. (L.B.S.)

30919 HIGH-SPEED PHASE METER FOR THE 8-MM REGION. L. Ya. Malykh, N. I. Malykh, N. F. Perepelkin, and E. S. Yampolskii (Inst. of Physics and Tech., Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 2, 93-5(Mar.-Apr. 1964). (In Russian)

A high-speed phase meter of the superheterodyne type for 8-mm waves is described. The phase meter can be used to determine the average density as a function of time by measuring the phase of signals transmitted across a plasma and for observation of the plasma critical surface density by measuring the phase of reflected signals. The phase meter can also be used for measuring the dielectric constant in the 8-mm range. (tr-auth)

30920 STABILITY OF A GRAVITATING CYLINDER IN THE PRESENCE OF MAGNETIC FIELDS. J. M. Gandhi (Univ. of Rajasthan, Jaipur, India). Proc. Natl. Inst. Sci. India, Pt. A, 29: 407-11(July 26, 1963).

The integral involving the change of magnetic energy due to a deformation of the form $r = R + a \cos kz$, k being the wave number of the disturbance in the axial z direction, of the boundary of an infinitely long gravitating cylinder of an incompressible, inviscid and infinitely conducting fluid in the presence of an axial magnetic field varying as $H_z \sim (R_0^2 - r^2)^n$, for all positive n's, including n = 0, has been evaluated in the form of rapidly convergent series. It is shown that, as the value of n increases, the value of the

root mean square magnetic field within the cylinder continuously increases and that the expressions for x^* and x_m, the wave numbers of the disturbance at which the gravitational instability first sets in and at which it is maximum, have the same forms as the ones obtained by Chandrasekhar and Fermi (1953) and Auluck and Kothari (1957). (auth)

30921 OSCILLATIONS OF A THREE-COMPONENT ASSEMBLY IN THE PRESENCE OF A MAGNETIC FIELD USING THE GENERALIZED BGK COLLISION MODEL. P. L. Bhatnagar and C. Devanathan (Indian Inst. of Science, Bangalore). Proc. Natl. Inst. Sci. India, Pt. A, 29: 474-99 (July 26, 1963).

The BGK collision model for one-component assembly of neutral particles is generalized to N-component assembly of both charged and neutral particles. This model is further applied to the study of small amplitude plasma oscillations in an assembly consisting of ions, electrons, and neutral particles in the direction perpendicular to a uniform magnetic field. Exact analytical and graphical discussion of the transverse dispersion relations is given. Longitudinal propagation is investigated under very restricted circumstance numerically and it is shown that, unless the magnetic field is very high, propagation is possible for all frequencies. (auth)

30922 OSCILLATIONS OF CONFINED PLASMA. G. A. Begiashvili and Yu. S. Monin. Radiotekhn. i Electron., 8: 1486-8(Aug. 1963). (In Russian)

Oscillations of a-c plasma confined between two parallel solid infinite planes in an external field were investigated. (R.V.J.)

30923 NONLINEAR STATIONARY OSCILLATIONS OF A POTENTIAL IN ION-ELECTRON FLUXES EMITTED BY A PLANE. V. M. Smirnov. Radiotekhn. i Elektron., 8: 1729-42(Oct. 1963). (In Russian)

Potential distributions in a one-dimensional ion-electron flux emitted by a plane source were classified for arbitrary initial ion and electron velocity distributions, disregarding collisions. Functions describing potential distribution when a part of the particles escape into infinity were found. (R.V.J.)

30924 BALLISTA OR BALL-THROWING DEVICE FOR MOMENTUM AND DENSITY MEASUREMENTS IN A ROTATING PLASMA. J. G. Bannenberg and F. G. Insinger (FOM Laboratorium voor Massascheiding, Amsterdam). Rev. Sci. Instr., 35: 792-5(July 1964).

A ball-throwing apparatus was built to be used as an instrument for measuring the local momentum and density of a plasma in a rotating plasma device. Reasons are given for the choice of this technique and the critical design parameters are discussed. The necessary timing equipment and calculation method are given. The time of flight of a launched ball is known with an accuracy of ±0.15%. (auth)

30925 PRODUCTION OF LOW DIVERGENCE POSITIVE ION BEAMS OF HIGH INTENSITY. N. B. Brooks, P. H. Rose, A. B. Wittkower, and R. P. Bastide (High Voltage Engineering Corp., Burlington, Mass.). Rev. Sci. Instr., 35: 894-901(July 1964).

Ion sources are described which take advantage of the focusing properties of a plasma boundary, thereby producing positive ion beams of very high directivity or brightness. It was found that by employing a considerable degree of space-charge neutralization beyond the accelerating-field region of the ion source, the beam formed by plasma-boundary focusing can be transported away from the source with low and constant divergence. It is also shown that the divergence of the beam could further be decreased by reducing the space-charge expansion of the ion beam in the acceleration region. The positive ions were removed from the plasma boundary in a region of high field gradient before being retarded to the required final energy as they left the ion source. By use of these three developments, low divergence, high intensity d-c ion beams were obtained, and a comparison between these and earlier results is provided. Under optimum conditions, 80 mamp of positive hydrogen ions at 30 kev, extracted from a 5.0-cm-diam plasma boundary, were transmitted through a 5.0-cm aperture placed 75 cm from the ion source. The beam emittance was measured to be 11×10^{-3} rad·cm·Mev$^{1/2}$ with a maximum half-angle divergence of 45×10^{-3} rad. (auth)

30926 LANGMUIR PROBE MEASUREMENTS IN THE PRESENCE OF OSCILLATIONS. A. Garschadden and P. Bletzinger (Aerospace Research Labs., Wright-Patterson AFB, Ohio). Rev. Sci. Instr., 35: 912-13(July 1964).

An improved experimental method to achieve Langmuir probe measurements during a low frequency oscillation in a gas discharge plasma is described. (C.E.S.)

30927 ON THE NONLINEAR THEORY OF POLARIZATION ENERGY LOSSES OF A BUNCH OF CHARGED PARTICLES IN A PLASMA. V. I. Miroshnichenko (Inst. of Physics and Tech., Khar'kov). Ukr. Fiz. Zh., 8: 1268-9 (1963). (In Ukrainian)

Studies were made of the energy losses of a charged disc moving in a wave guide filled with plasma. Maxwell equations and equations of electron motion in the plasma (considering the ions static) are used as an initial system of equations. (R.V.J.)

30928 LANGMUIR PROBE AND VELOCITY MEASUREMENTS IN THE ARDE PLASMA JET. W. A. Clayden (Royal Armament Research and Development Establishment, Fort Halstead, Kent, Eng.). p.419-46 of "The High Temperature Aspects of Hypersonic Flow." Oxford, Pergamon Press, 1964.

Two techniques have recently been developed for the ARDE plasma jet to measure (a) the velocity and (b) the electron density and temperature of the ionized stream. The velocity has been obtained from the measurements of the potential produced by a magnetic field normal to the direction of flow of ionized gases and a typical velocity is 10^5 cm/sec. The effects of the degree of ionization, shape of probes and the eddy currents on the velocity measurements are discussed. A simple theory is given for the interpretation of results from a Langmuir probe operating in a hypersonic plasma flow when the mean free path of the neutral particles is larger and the Debye length smaller than a typical probe dimension; typical measurements give an electron density of 10^{13} electron/cm^3 and a temperature of 2000°K. (auth)

30929 RADIATION MEASUREMENTS FROM THE PLASMA SHEATH SURROUNDING HYPERSONIC PROJECTILES. A. Lemay (Canadian Armament Research and Development Establishment, Valcartier, P. Q.). p.555-67 of "The High Temperature Aspects of Hypersonic Flow." Oxford, Pergamon Press, 1964.

Results of measurements of passive radiation from the plasma sheath surrounding a hypersonic projectile are presented appropriate to various re-entry flight conditions. The measurements fall into three broad categories corresponding to three main types of experiments performed: (a) those of total intensity of radiation from the stagnation region within given spectral bandwidths, obtained using photodetectors, (b) those of spectral distribution of intensities for the integrated radiation from the plasma as a

whole, obtained using conventional spectrographs and (c) those of spatial distribution of intensities within a given spectral bandwidth, obtained using an image converter camera. The results are of particular interest in the study of relaxation and ablation phenomena, and yield some preliminary information on wake structure. (auth)

30930 ISKUSSTVENNYE SPUTNIKI V RAZREZHENNOI PLAZME. (Artificial Satellites in a Rarefied Plasma). Ya. L. Al'pert, A. V. Gurevich, and L. P. Pitaevskii. Moscow, Publishing House "Science," 1964. 382p.

A survey is made of various phenomena appearing in the motion of artificial earth satellites in the ionosphere and the interplanetary medium. The case of a quickly moving body, whose speed is significantly greater than the speed of the particles in the plasma, is investigated very fully. The problem of the scattering of electromagnetic waves in the medium which the satellite forms in its movement is surveyed in detail, using strict probe theory. (tr-auth)

30931 LANDAU DAMPING IN THE PLASMA SHEATH. H. L. Stover and G. S. Kino (Stanford Univ., Calif.). 14p. (CONF-471-24)

From American Physical Society 5th Annual Meeting, San Diego, Calif., Nov. 1963.

The dispersion characteristics and attenuation of slow waves propagating along a finite plasma column are measured. The loss is found to be considerably higher at high frequencies than would be expected from collisions of electrons with neutrals or ions. A detailed propagation theory is presented that takes account of the radial variation of density in a Hg-vapor discharge plasma. Attenuation resulting from sheath impedance and elastic collisions with neutrals is calculated. Experimental and theoretical results are compared, and the results are found to be compatible with the hypothesis of Landau damping in the sheath. (auth)

30932 THE ENTRY OF A TENUOUS PLASMA INTO AN AXIAL MAGNETIC FIELD. D. E. T. F. Ashby (United Kingdom Atomic Energy Authority, Abingdon, Berks, Eng.). 16p. (CONF-471-27)

From American Physical Society 5th Annual Meeting, San Diego, Calif., Nov. 1963.

A coaxial gun is used to inject a burst of energetic, low-density hydrogen plasma along the axis of the magnetic field produced by a long solenoid. The portion of this plasma which penetrates the magnetic field has a density of 10^{11} to 10^{12} electrons/cm^3 and a mean directed energy of 10 to 20 kev. The properties of the plasma have been studied as it moves along the magnetic field. The mean ion velocity perpendicular to the magnetic field has been measured with Faraday cups, and the transverse energy of the plasma has been deduced from its diamagnetism. These measurements show that the transverse energy of the plasma resides predominantly in the ions, and that it has considerable angular momentum. It is shown that this momentum is produced by electrons flowing from the walls of the vacuum chamber as the plasma enters the cusp-shaped field at the end of the solenoid. (auth)

30933 EARLY-TIME COLLECTIVE EFFECTS IN A PLASMA BETATRON. S. J. Lukasik and K. C. Rogers (Army Electronics Material Agency, Fort Monmouth, N. J.). 47p. (CONF-471-22; SIT-114)

From American Physical Society 5th Annual Meeting, San Diego, Calif., Nov. 1963.

Electrostatic collective effects occurring during startup have been examined numerically in a simple model of a plasma betatron having a uniform guide field, with vector potential $A_\phi(r,t) = 0.5\ B_0 [r + 1.3\ r_1^2/r] \sin \omega t$. A region in the neighborhood of the equilibrium orbit, populated by an initially uniform zero temperature distribution of electrons and infinitely heavy ions, was divided into cells. The trajectory of each particle of a cell was taken to be that of the central particle. The electrostatic force acting on a particle during a time step was calculated from the charge distribution obtaining at the end of the preceding time step. Typical values of parameters were: electron density $10^9 \leq n \leq 10^{12}$ cm^{-3}, $B_0 = 50$ kilogauss, $\omega = 10^6$ sec^{-1}, $r_1 = 5$ cm. Rapidly growing (e−folding time $2\pi/\omega_p$) radial plasma oscillations $\omega_r \simeq \omega_p = (ne^2/\epsilon_0 m)^{1/2}$ excited by betatron oscillations $\omega_b = (e/m)\ B_0 \sin \omega t$ were observed. The addition of a B_φ guide field had an inhibiting effect on the growth of the plasma oscillations. (auth)

30934 A SIMPLIFIED COLLISIONAL MODEL STUDY OF INCOHERENT SCATTER FROM A PLASMA. R. A. Pappert (General Dynamics Astronautics, San Diego, Calif.). 33p. (CONF-471-19)

From American Physical Society 5th Annual Meeting, San Diego, Calif., Nov. 1963.

Collisional effects on the spectrum of radiation incoherently scattered from a plasma are studied by using a simplified representation of the collision integral. This representation has the merit of instantaneous particle conservation. The Nyquist theorem is used to develop the necessary spectrum functions and thus the study is restricted to an equilibrium plasma. Dimensionless parameters, y_j, equal to the ratio of the collision frequency of species j, to the Doppler frequency corresponding to the most probable thermal speed of species j, play a significant role in determining the shape of the spectrum. In the strong collision limit (defined as $y_j^2 \gg 1$ for all charged species), with the qualification that the electron collision frequency be much less than the frequency of the incident radiation, the simplified collisional model yields, to a good approximation, a spectrum that is the sum of two Lorentzians. The spectrum associated with the two Lorentzians is characteristically narrower and more highly peaked than the collisionless spectrum and has the property that the integrated intensity is precisely the same as the collisionless plasma result for the total integrated intensity. On the other hand, in the strong collision limit a simple relaxation model in which particles are not instantaneously conserved yields a greatly reduced integrated intensity. Illustrative curves are presented for the cases $y_j = 1$ and 5 as well as for a case appropriate to backscatter of 50 Mc radiation from the ionosphere at about 100 km. The stability of the models used is proven. This puts on a mathematically rigorous footing (at least for the magnetic-field-free case) the result that the total integrated intensity associated with the model used is independent of the collision frequencies. (auth)

30935 THE MAGNETIC AND IONIC STRUCTURE OF AN ELECTROMAGNETICALLY PRODUCED SHOCK. H. Guthart and T. Morita (Stanford Research Inst., Menlo Park, Calif.). 47p. (CONF-471-17)

From American Physical Society 5th Annual Meeting, San Diego, Calif., Nov. 1963.

The structure of the gas behind a strong shock generated by an electromagnetic shock tube has been investigated using magnetic pickup loops, an asymmetrical ion probe, an image converter camera, and a piezoelectric pressure probe. The shock tube consists of a Pyrex tube of adjustable length connected to a conical discharge section. Four 7.5-μf capacitors were charged to 12 kv and fired into the tube at a pressure of 30 μHg. The azimuthal magnetic field generated by the electrical discharge is "frozen" into the gas behind the shock because of the high magnetic Reyn-

olds number (~2). Its transverse distribution is shown to be consistent with a toroidal current hypothesis and a multipole axial distribution corresponding to the damped sinusoidal wave shape of the current in the external circuit. The peak magnetic field strength measured 5000 gauss at 10 cm from the discharge section and 20 gauss at 40 cm. The peak ion concentration was observed to be 8×10^{14} cm^{-3} at 50 cm and 3×10^{14} cm^{-3} at 190 cm from the discharge section. A precursor ion density three orders of magnitude below the shock maximum is also observed 6 cm in front of the shock at a position 70 cm from the discharge section. (auth)

30936 THE MAGNETOGASDYNAMIC VISCOUS SHOCK LAYER IN HYPERSONIC FLOW. Shih-Yuan Chen (Boeing Co., Seattle). 16p. (CONF-542-1)

From 5th Symposium of the Engineering Aspects of Magnetohydrodynamics, Cambridge, Mass., Apr. 1964.

The effects of magnetic field, wall temperature, and density ratio on low-density hypersonic flow past blunt-nose bodies are studied. The shock shape is assumed to be a sphere concentric with the body shape. The shock layer is assumed to be compressible, viscous, thin, and to have constant electrical properties. It is shown that the effects of magnetic field are to increase both enthalpy ratio distribution and shock standoff distance and to reduce velocity distribution as well as heating rate. The effects of wall temperature are to increase enthalpy distribution and to reduce velocity ratio distribution, shock standoff distance, and heating rate. The effect of density ratio is to increase heating rate. It is also shown that a 45-percent or more reduction in heating rate can be accomplished by using an external magnetic field of moderate flux density in low-density hypersonic flow. (auth)

Shielding

Refer also to abstract 30705.

30937 (AEC-tr-6231(p.48-55)) BACKSCATTERING OF GAMMA RAYS BY LAYERS OF MATTER. M. Kawamura, K. Kimura, Y. Nakai, and H. Iomo. (Translation)

The backscattering of gamma rays by layers of different materials was studied qualitatively using a ^{60}Co point source and a scintillation spectrometer. Results are reported for a 0.3-cm thick layer of Pb or Fe at various depths in 3.0-cm thick Al. The backscattering was found to be smallest when the Pb layer was facing the source and greatest when the Fe layer was facing the source, and reasons for this effect are discussed. Backscattering was also measured for Pb, Fe, and Al alone. It is concluded that the arrangement of shielding materials is important in radiation shielding. (D.L.C.)

30938 (AEC-tr-6231(p.56-60)) SIMPLIFIED METHOD OF DETERMINATION OF ABSORPTION COEFFICIENT OF GAMMA RAYS. Y. Nakai and M. Kawamura. (Translation)

Semi-empirical equations were derived for the gamma absorption coefficients of Al, Fe, Pb, H_2O, and concrete. The equations are in the form of quadratic expressions on log-log plots, and some computed values are compared with these of G. W. Grodstein and others. (D.L.C.)

30939 HIGH ENERGY X-RAY PHOTON ALBEDO. J. S. Pruitt (National Bureau of Standards, Washington, D. C.). Nucl. Instr. Methods, 27: 23-8(Apr. 1964).

A sodium iodide scintillation spectrometer was used to determine albedo photon spectra for thick targets of C, Mg, Cu, Sn, and Pb bombarded by bremsstrahlung with a maximum photon energy of 90 Mev and for Pb at 25, 50, and 170 Mev. The measurements were also used to determine the total energy albedo in these cases with an accuracy of the order of 15%. (auth)

30940 DEMAGNETIZATION OF MAGNETIC SHIELD IN THE PRESENCE OF THE EARTH'S FIELD. W. B. Herrmannsfeldt and B. L. Salsburg (Stanford Univ., Calif.). Rev. Sci. Instr., 35: 906(July 1964).

It is shown that the ability of conventional magnetic shielding materials to shield against d-c fields such as the geomagnetic field can be significantly improved by demagnetizing the shield after it is installed. The demagnetization actually magnetizes the shield to exactly cancel the external d-c field. If the external field changes in any way or if the shield is disturbed the effect is lost. The phenomena were observed in the magnetic shield for the Stanford linear accelerator. (C.E.S.)

30941 MONTE CARLO CALCULATION OF THE PENETRATION AND DIFFUSION OF FAST CHARGED PARTICLES. Martin J. Berger (National Bureau of Standards, Washington, D. C.). p.135-215 of "Methods in Compu tational Physics. Vol. I." New York, Academic Press, 1963.

A procedure is described for simulation, by random sampling, of the multiple Coulomb scattering of fast charged particles for solution of electron and proton transport problems. Results for backscattering, penetration, energy dissipation, slowing-down, and pathlength distributions of electrons and for penetration of protons are compared with experimental observations. (D.C.W.)

REACTOR TECHNOLOGY

General

Refer also to abstract 30094.

30942 (BAW-3198-2) CLOSED-TANK VAPOR SUPPRESSION TEST PROGRAM. F. L. Hovanec (Babcock and Wilcox Co. Research Center, Alliance, Ohio) and R. C. Luken (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). May 1964. Contract AT(30-1)-3198. 92p.

The initial Vapor Suppression Test Program, conducted in an open tank, demonstrated the feasibility of operating a nuclear power plant in a water-filled containment. To give a more compact design, the pressure containment used in the closed-tank design differs from the Humbolt Bay design in that it does not require a dry well; instead, the reactor vessel is submerged in water. A test facility was modified to include a closed containment tank. To observe the actual pressure buildup following a rupture, the tank was designed for 100 psig. In addition, a mockup of a typical reactor vessel head containing control rods was simulated. Twenty-six rupture tests were conducted with 2-, 3-, and 6-inch-diameter ruptures, representative of those that might occur in the control rod housings. A containment water depth of 4 to 6 feet above the rutpure proved to be the most effective level for reducing pressure. However, by placing a baffle plate above the rupture, this water depth can be reduced to 1 foot. Generally, the final pressure was between 8 and 10 psig. Excepting for the above-surface ruptures, the highest transient tank pressure was 41.5 psig. This compares with a calculated pressure of 370 psia when the tank is empty. The forces imposed on the control rods are not excessive. A conservative design value for the maximum force would be the product of the primary system pressure and the anticipated maximum rupture area. Based on the information obtained in the open- and closed-tank tests, sufficient data are available to predict the maximum sustained containment tank pressures. Although rupture tests of up to 6 inches in diameter have been conducted, it is indicated that larger sized ruptures would produce greater mixing and hence lower end pressures. Transient pressures can be minimized by using baffles, and shock problems are minimal. (auth)

30943 (CEA-R-2403) FORMULATION DES REPARTITIONS SPECTRALES ENERGETIQUES DE FLUX NEUTRONIQUES EN PILE (ENERGIES SUPERIEURES A QUELQUES CENTAINES D'ELECTRONS-VOLTS). (Formulation of the Energetic Spectral Distribution of In-Pile Neutron Flux (Energies Greater than a Few Hundred Electron Volts)). Jean-Pierre Genthon (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). Apr. 1964. 120p.

An expression is deduced for the spectral distribution of flux over a few hundred electron volts; it is valid for most cases of thermal reactors. Various common reactor materials are considered in flux calculations. (R.E.U.)

30944 (EUR-1630-e) THE EUROPEAN COMMUNITY ACTIVITIES IN THE FAST REACTOR FIELD. A. de Stordeur (European Atomic Energy Community). 1964. 12p. (CONF-193-9)

From the 8th Nuclear Congress, Rome, June 1963.

The activities of the Euratom Commission in the fast-reactor field during their second five-year program are concentrated in the three associations, which have been approved by the different Community instances and by the Council of Ministers. The C.E.A.-Euratom association program is directed toward sodium cooled fast reactors and is carried out in Cadarache. The main realizations in Euratom second five-year program are Rapsodie (20 Mw(th) reactor), Masurca (Pu-fueled critical assembly), and Harmonie (fast source reactor). The Karlsruhe-Euratom association program is covering sodium-, helium-, and steam-cooled fast reactors. The main realizations in Euratom second five-year program are Sneak (Pu-fueled critical assembly), Stark (fast thermal coupled reactor), and Suak (subcritical assembly experiments). The preliminary intent of the Euratom-CNEN association program is the investigation of pastes as reactor fuel for uranium–thorium cycle. Several tools belonging to CNEN will be used by the association. The association efforts will be complemented by those of Euratom common research center and in particular Ispra and Karlsruhe. The industrial programs announced in the Community are also reviewed. (auth)

30945 (HW-80957) TRANS: A COMPUTER PROGRAM FOR THE DETERMINATION OF THE AMPLITUDE AND PHASE SHIFT OF THE ZERO POWER REACTOR TRANSFER FUNCTION. T. B. Thornbury and E. L. Kelley (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [Mar. 16, 1964]. Contract AT(45-1)-1350. 8p.

A program is described for computing the amplitude and phase shifts for oscillatory periods of 1.0 to 100.0 sec/cycle. Two binary decks for IBM 7090 are available for running TRANS: plot and no-plot. (R.E.U.)

30946 (JUL-156-RE) REAKTORPRAKTIKUM. (Reactor Laboratory Manual). H. J. Bormann, L. Dieck, K. Feese, K. L. Frenkler, J. Jacquemin, H. Jahn, and K. J. Kalker—W. Porschen, ed. (Kernforschungsanlage, Julich, Germany). Nov. 1963. 123p.

A reactor laboratory manual designed to give the technical or scientifically trained person with knowledge in reactor physics familiarity with experimental methods is presented. Basic measurement techniques are given for neutrons and α, β, and γ radiations. The measurement of diffusion constants, diffusion lengths, and effective cross sections with a pulsed neutron source is illustrated. A practical introduction is given to the study of reactor kinetics with analog computers. A series of experiments on a reactor is also included. In conclusion, examples are given of the use of reactor radiation and some special measurement methods. (J.S.R.)

30947 (NAA-SR-7264) OSCILLATION MEASUREMENTS IN THE SODIUM REACTOR EXPERIMENT. C. W. Griffin and R. W. Keaten (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). June 15, 1964. Contract AT-11-1-GEN-8. 25p.

Measurement of the reactor transfer function with a pile oscillator was used to determine the zero power and "at-power" characteristics of the second fuel loading of the Sodium Reactor Experiment. At zero-power the results yielded $\ell^*/\beta_{eff} = 0.075$ sec, in good agreement with results on the first fuel loading. Measurements at power were first performed while the core had a positive prompt temperature coefficient associated with fuel rod bowing. The transfer function below 0.1 cps exhibited an increase in

gain and decrease in phase angle compared to zero power. In addition, a complicated resonance structure was observed from 0.1 to 0.5 cps. This was associated with sustained flux oscillations of the same frequency. The transfer function results lead, in part, to a mathematical model describing the cause of the positive coefficient. After the clusters were constrained to prevent fuel rod bowing, the transfer function clearly demonstrated the elimination of the positive coefficient and associated effects. (auth)

30948 (NP-14079) THE MECHANISM OF INTERFERENCE PICKUP IN ELECTRONIC EQUIPMENT WITH SPECIAL REFERENCE TO NUCLEAR POWER STATIONS. D. Harrison (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Apr. 15, 1964. 32p.

The various forms of electrical interference in nucleonic reactor control equipment were recently studied in the U.K.A.E.A. The results of this work are discussed and an analysis is made of interference due to interconnecting cables. Other causes of interference are mentioned and a method of in situ testing is described that can be used to diagnose the sources of interference pickup and to establish the interference sensitivity of a completed installation. (auth)

30949 (NYO-9077) A MANUAL OF EXPERIMENTS IN REACTOR PHYSICS. Frank A. Valente, ed. (Rensselaer Polytechnic Inst., Troy, N. Y.). Aug. 1961. Contract AT(30-3)-294. 499p.

Statistics of counting, radioactivity, instrumentation, pulsed-neutron techniques, and radiological considerations for reactor experiments are discussed. Ten experiments requiring steady sources of neutrons, 6 experiments requiring a subcritical assembly and a steady source of neutrons, and 6 experiments requiring a subcritical assembly and a pulsed source of neutrons are discussed. (R.E.U.)

30950 (TID-3525(Rev.5, Suppl.1)) REACTOR SAFETY. A Literature Search. Richard J. Smith, comp. (Division of Technical Information Extension, AEC). Mar. 1964. 74p.

A total of 422 references to unclassified reports and published literature is presented on reactor systems, materials, and operation designed to provide maximum safety for the reactor, reactor personnel, and environs. Information is included concerning incidents and conditions of operation considered hazardous. Author, reactor, and report number and availability indexes are provided. (auth)

Auxiliaries and Components

30951 (BMI-X-271) A STUDY OF SHAFT SEALING CONCEPTS FOR CIRCULATING PUMPS FOR PRESSURIZED WATER REACTOR APPLICATION. Résumé of Literature. C. M. Allen, D. R. Grieser, J. W. Kissel, and W. G. Rieder (Battelle Memorial Inst., Columbus, Ohio). Mar. 26, 1963. Contract W-7405-eng-92. 54p.

Mechanical face and stuffing-box sealing concepts were considered. 59 references. (R.E.U.)

30952 (ORNL-3619(p.24-57)) IRRADIATION TESTING OF COMPONENTS AND MATERIALS. D. B. Trauger and O. Sisman (Oak Ridge National Lab., Tenn.).

Three prototype-diameter capsules were examined that had been irradiated for evaluating production-run EGCR fuel and cladding material. No unusual effects were observed in two of the capsules, but the third capsule had fractures in both the cladding and the NaK vessel. Nitriding of the outer surface of the NaK vessel had embrittled the vessel wall. Severe overheating of the UO_2 in the capsule had also occurred. Preliminary examination of four capsules removed from the ETR indicated that two of the capsules had failed. Fission-product ^{137}Cs was found in the NaK surrounding both capsules, and there was a visible fracture in the cladding of one. The other could not be removed from its NaK vessel by normal procedures. There were no obvious defects in the other two capsules. An ORR-irradiated capsule was examined that was larger in diameter than the prototype-diameter capsules and had spiral ridges machined in the cladding for greater heat transfer. A tentative model for high-temperature fission-gas release was formulated based on fission-gas-release data for single-crystal UO_2 specimens. The essential premises of the model are that defects in the UO_2 structure will trap impurity atoms, that defects are formed by fission fragment tracks, and that the fission-gas release is controlled by the probability of the gas being trapped rather than by a diffusion process. With this model, all observed characteristics of in-pile gas release can be explained qualitatively. The gas release from fine-grained UO_2 specimens of the same size and density as the single-crystal specimens, but having many more internal defects (since the grain boundaries are considered defects), was less than one-fifth that from the single-crystal UO_2 for the same irradiation conditions. A decrease in gas release was predicted by the model. Samples were prepared for the EGCR pressure-vessel surveillance program. Impact tests were run on unirradiated samples of base-plate material, weld metal, and heat-affected-zone specimens. Base-plate material of the heat used for the equatorial belt-line of the vessel was found to have poorer notch ductility than samples of the other heats used. The tests showed also that the transition temperature of the stress-relieved weld metal was significantly lower than that of the base-plate material. Heat-affected-zone samples showed a reduction in notch ductility in comparison with as-received base plate. A stress-relief treatment gave some improvement. (auth)

30953 (ORNL-3619(p.147-200)) INVESTIGATION OF MODERATOR MATERIALS. A. Goldman, G. M. Watson, B. L. Greenstreet, and H. W. Savage (Oak Ridge National Lab., Tenn.).

Investigations are reported of: radiation effects on graphite; in-pile creep of graphite; design criteria for graphite components; effects of radioinduced creep on stress and strain distributions in graphite; failure characteristics of graphite; oxidation of graphite by oxidants in He; graphite oxidation and mass transfer in low-pressure loops; Be self-diffusion in BeO; and fast-neutron radiation effects on BeO components. (T.F.H.)

30954 (ORNL-3619(p.359-65)) FACILITIES AND EQUIPMENT. (Oak Ridge National Lab., Tenn.).

Two regenerative grease-lubricated compressors were removed from GCR-ORR loops after 5500 and 6600 hr of operation at speeds ranging from 6000 to 12,000 rpm. Only routine maintenance was required. A similar compressor was tested with nitrogen and with CO_2 to determine limiting conditions for operation in the ORR loops. Ionization detectors for the process analysis of helium were evaluated. Two of these detectors, the r-f-ionization detector and the electron mobility detector, were found to offer no general improvement over the sensitivity of thermistor detectors. The breakdown detector was found to be sensitive to sub-ppm concentrations of H_2, O_2, N_2, CH_4, and CO. Fabrication of the Lipsky detector was completed. Twenty-five metals were tested for thermoelectric stability under environmental conditions approaching those of the pebble-bed reactor experiment. Metals were found exhibiting 2% or less

error in their output against platinum after exposure to helium contaminated with H_2 and CO for 141 days at 1800°F. (auth)

30955 (ORNL-TM-813) FEASIBILITY STUDY OF PRESTRESSED CONCRETE PRESSURE VESSEL DESIGN. Zenons Zudans and Chen Pang Tan (Franklin Inst., Philadelphia). June 1964. For Oak Ridge National Lab., Tenn. Contract W-7405-eng-26, Subcontract No. 2222. 101p.

The technology of prestressed concrete pressure vessels is studied. The design analysis consists of a stress analysis of the vessel, a determination of prestressing steel cable distribution, and calculations of temperature distributions, resulting thermal stresses throughout the concrete, and the combined stresses due to pressure and temperature. Criteria for the design include zero tensile stress in the concrete under all loading conditions and a maximum allowable compressive stress in the concrete of 0.45 times the ultimate compressive strength of the concrete. The initial prestress was calculated to include allowances for loss of prestress due to shrinkage and creep of the concrete during the life of the vessel. In prestressed concrete pressure vessels the concrete is preloaded biaxially in compression through tensile prestressing of two sets of cables at right angles to each other. One set of cables provides circumferential prestress and the other provides axial prestress. For the vessel analyzed in this study, ultimate load factors were calculated for cables throughout the vessel by dividing the ultimate strengths of the cables by the load on them at design pressure. For the circumferential cables this factor varies from 2.2 to 6.3, and in axial cables it varies between 4.7 and 8.6. In steel pressure vessels where biaxial stresses are carried by the same material, comparable factors commonly are taken as 4.0. The analysis shows that it is practical to design a 50-ft inside-diameter vessel for 575-psi service with design stresses in the concrete below the maximum allowable value, and this can be done using commercially available prestressing cables and anchors. However, in the particular design selected, the criterion of no tensile stress in the concrete is not met in some local spots where thermal stresses are high. Changes in geometry, prestressing, cooling, and insulation can be made to readjust these results to the criterion. However, some local tension in the concrete only means localized cracking, which tends to relieve the thermal stress and does not result in gross failure of the vessel because the load is carried by the prestressing cables. (auth)

30956 A PRECISE DIGITAL PERIOD METER FOR A NUCLEAR REACTOR. C. H. Vincent, J. B. Rowles, and R. A. W. Steels (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nucl. Instr. Methods, 26: 221-37(Mar. 1964).

A new type of reactor period meter was developed, using digital principals. It gives an immediate reading of the inverse period in decimal form. The logarithmic action required is obtained by means of a circuit which was used previously in a digital linear ratemeter. The necessary time-scale is obtained by reference to a crystal-controlled oscillator, and the accuracy, up to very high accuracies, is determined almost entirely by the statistical limitations inherent in the information contained in the train of pulses entering the instrument during the selected measuring time. The digital period meter is very flexible and can be used either to obtain a rapid indication or to make precise measurements of long periods. A permanent record of pulse counts and periods can be obtained, if required. The circuits are largely repetitive and are very suitable for modern construction techniques. (auth)

Criticality Studies

Refer also to abstract 30992.

30957 (AEEW-R-348) MEASUREMENTS OF BUCKLING AND Pu239/U235 RELATIVE REACTION RATES IN AN UNDERMODERATED GRAPHITE ASSEMBLY FUELLED WITH HIGHLY ENRICHED U235 AND Pu239. E. J. Maunders (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Apr. 1964. 39p.

As part of a general program of work on intermediate reactor assemblies, a series of measurements were made in a subcritical plutonium-fueled, graphite moderated system in which S, the ratio of moderator to fissile atoms, was 920, and in a ^{235}U fueled system in which S was 440, to determine the flux fine-structure, the material buckling, and the relative $^{239}Pu/^{235}U$ reaction rates. Predictions of material buckling and the shape of the neutron energy spectrum were made using a Parks scattering kernel, a Schofield scattering kernel, and a Free Gas Model together with what is basically OCUSOL (See ANL 5800) group-averaged nuclear data, and also with the point tabulated data from the Winfrith Nuclear Data File. Unfortunately, the latter does not give a good representation of the cross section between 4 and 60 ev. The $^{239}Pu/^{235}U$ relative reaction rates predicted by the Parks model using OCUSOL group-averaged data are in good agreement with the measured values in both assemblies although the values predicted by the other models using this data are not very different. With the Winfrith Nuclear Data File, discrepancies of as much as 20% arise between predicted and observed values of this reaction rate ratio. With OCUSOL data, satisfactory agreement is obtained between predicted and observed values of B_m^2 for the ^{235}U fueled assembly, but for the ^{239}Pu fueled assembly better agreement was found when the η value for the ^{239}Pu was increased by 25% at energies above 10 ev. For both assemblies using the Winfrith Nuclear Data File leads to values of B_m^2 up to 6% lower than those predicted using OCUSOL data. (auth)

30958 (TID-7028) CRITICAL DIMENSIONS OF SYSTEMS CONTAINING U^{235}, Pu^{239} AND U^{233}. H. C. Paxton, J. T. Thomas, Dixon Callihan, and E. B. Johnson (Los Alamos Scientific Lab., N. Mex. and Oak Ridge National Lab., Tenn.). June 1964. Contract W-7405-eng-36. 150p.

A compilation of critical data obtained from experiments performed since 1945 is presented. The report supplements the Nuclear Safety Guide [TID-7016(Rev.1)] and shows the bases of the recommendations that appear in the Guide. Conversions to standard geometries is shown. Results are given for single units and multiple-unit arrays. 130 references. [Table 4, p.34—the last set of data applies to an unreflected 16.2-in. diameter cylinder.] (R.E.U.)

30959 DETERMINATION OF THE EFFECTIVE FRACTION OF DELAYED NEUTRONS IN A REACTOR OR MULTIPLICATION CONFIGURATION. J. L. De Francisco Sainz (Junta de Energia Nuclear, Madrid). Anales Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 60: 19-28(Jan.-Feb. 1964).

Two methods are given for the determination of the effective delayed neutrons fraction β_{ef}. The first is an extension of the boron substitution technique consisting of the measurement of the reactivity change introduced by a neu-

tron poison. The second is a purely analytical method without any need of experiments. (auth)

30960 RELATIVE MEASUREMENT OF THE THERMAL NEUTRON FLUX DISTRIBUTIONS. C. Desandre and C. Hyver. Bull. Inform. Sci. Tech. (Paris), No. 81, 13-15 (Mar. 1964). (In French)

The various possibilities offered for determining a thermal flux distribution in a reactor are discussed. The advantages and disadvantages of these different methods are outlined with stress on the fact that the choice of one of these techniques depends on the particular case under consideration. (auth)

30961 VALIDITY ON THE CYLINDRICAL CELL APPROXIMATION IN LATTICE CALCULATIONS. Y. Fukai (Nippon Atomic Industry Group Co., Ltd., Tokyo). J. Nucl. Energy, Pt. A & B, 18: 241-59(May 1964).

An error introduced by cylindricalizing an actual lattice is estimated, using collision probabilities obtained by extending a given method to the multi-region problem. After the accuracy of the calculated probabilities is discussed, the fuel escape probabilities, which have an accuracy of the order of less than 0.0002, are tabulated for the cases of the cylindricalized, hexagonal, and rectangular lattices. It is proved that the homogeneous limit for the probability equation is physically reasonable, and that the cylindrical cell approximation is not always better in the hexagonal lattice calculation than in the rectangular one. Next, more accurate values of the flux ratio in various lattices are presented after the propriety of the flat flux approximation is discussed. Since the cylindricalizing errors calculated by the flat flux approximation agree with the exact ones, they are extensively investigated using this approximation. It is concluded that these approximate errors increase as the moderator mean chord length divided by the mean free path and the scattering ratio in the fuel decreases, and the fuel mean chord length divided by the mean free path increases. Finally, it is proposed that the trend of the error calculated by the P_1 theory is qualitatively different from the one by the collision-probability method, and the two-cell boundary conditions suggested in the cylindricalized cell calculation are inconsistent except for the P_1 theory. Results from the P_N approximation are also compared with the more accurate ones. (auth)

30962 EXPERIMENTAL DETERMINATION OF AN ANISOTROPIC NEUTRON FLUX DISTRIBUTION AND COMPARISON WITH THE S_n THEORY. H. Beuchat (Institut für Reaktorforschung, Würenlingen AG, Ger.). Neue Tech., 6: 131-7(June 1964). (In German)

An experimental device, which permits the measurement of differential neutron flux, is described. The results were compared with a transport theory (S_n-Method) and showed good agreement. (auth)

30963 AN ANALYSIS OF 23 ZPR-III FAST-REACTOR CRITICAL EXPERIMENTS. William G. Davey (Argonne National Lab., Idaho Falls, Idaho). Nucl. Sci. Eng., 19: 259-73(July 1964).

Over fifty fast critical assemblies were studied in the Zero Power Reactor-III (ZPR-III). All of these assemblies were fueled with ^{235}U and reflected with depleted uranium; the core volumes ranged from 2 to 660 liters and the critical masses ranged from 26 to 580 kg of ^{235}U. The experimental characteristics of a representative group of 23 of these assemblies in which oxide, carbide, and metallic fuels were simulated were compared with calculated values. The parameters studied were critical size, central fission ratios, prompt-neutron lifetimes and the reactivity effects of substitution of various materials at the reactor center. (auth)

30964 DYNAMICS OF AN ADIABATIC POINT REACTOR. José Canosa (Harvard Univ., Cambridge, Mass.). Nucl. Sci. Eng., 19: 329-42(July 1964).

The problem of adiabatic excursions in a reactor is studied in general. The prompt temperature reactivity feedback is an unspecified function of temperature, $\rho = \rho_0 + f(T)$, where ρ is total reactivity, ρ_0 initial step reactivity and f(T) the feedback function. The similarity of the behavior of the reactor for different f(T) is established by means of a topological (qualitative) analysis. A quantitative asymptotic solution of the non-linear system of DE describing the reactor is presented. In delayed critical excursions, the delayed neutrons play a determining role. In the first part of a prompt excursion, the delayed-neutron source is nil; however this is not so in the second part, where it contributes appreciably to the excursion. These conclusions are shown to be valid in general, and allow us to write down almost directly the (approximate) quantitative solution of the non-linear system for any f(T). These results are correlated with the experimental data for the adiabatic excursions of a UO_2 core in SPERT I; in this case the (prompt) dependence of the reactivity on energy is of the form $\rho = \rho_0 - 4.588 \times 10^{-4} E^{0.74}$. (auth)

30965 CALCULATION OF DISADVANTAGE FACTORS FOR SMALL CELLS. Z. Weiss and R. J. J. Stamm'ler (Institutt for Atomenergi, Kjeller, Norway). Nucl. Sci. Eng., 19: 374-7(July 1964).

The calculation of the disadvantage factor for small reactor cells is discussed. The behavior of the disadvantage factor when the moderator thickness is mean free paths goes to zero is considered. It is shown that the disadvantage factor does not increase monotonically with decreasing moderator thickness, but has a logarithmic singularity in its first derivative that causes it to increase from a certain point. (C.E.S.)

Design and Feasibility

30966 (UJV-1030/64) OPTIMUM DIGITAL INFORMATION TREATMENT AND NUCLEAR ENGINEERING INSTRUMENTATION. P. Kovanic (Československá Akademie Věd. Ústav Jaderného Výzkumu, Řež). [1964]. 23p.

The numerical operation of the filtration, interpolation, and extrapolation of a function the values of which are given with statistical errors, or similar operations with derivatives, integrals of this function or linear combinations thereof, may be carried out by determining the scalar product of the vector of input values and the vector-operator. The method for calculating the vector-operator which minimizes the variance of the results of the operation is given and a close connection with the method of smoothing the input data with a polynomial minimizing the square error sums in nodes is shown. The method is used to solve a number of problems. A simple optimum estimator calculating the ratio of the scalar products may be used for the realization of the operations mentioned. Possible applications comprise the accurate measurement of the reactor period, dynamic reactivity measurement, treatment of the results of physical measurements, application in optimum control systems, etc. The method may be also used for simplifying the calculations when using the least square method and especially for determining the errors originated in such calculations. (auth)

30967 STANDARD PILES. M. De Beaucourt, M. Boyer, M. Denis, M. Hyver, and M. Prodoscimi. Bull. Inform. Sci. Tech. (Paris), No. 81, 39-42(Mar. 1964). (In French)

A survey on the standard pile is presented with a description of the main problem, power construction, neu-

trons sources, moderators, and shieldings. Flux measurements may be made by calibration by activation of ^{197}Au with absolute determination by means of coincidence ($\beta\ \gamma$). Flux calculation by means of Fermi age was considered. Brief descriptions of standard piles belonging to the C.E.A. are given. (auth)

30968 STANDARDIZATION OF A Ra–Be NEUTRON SOURCE FOR USE IN A STANDARD PILE. A. Capgras. Bull. Inform. Sci. Tech. (Paris), No. 81, 45-7(Mar. 1964). (In French)

The calibration of a (Ra–Be) neutron source with respect to a (Ra–Be) standard source is described. The method of the manganese bath and that of the long counter is used. The results obtained by both methods agreed, but the first was more accurate. (auth)

30969 INCREASING OF HEAT OUTPUT OF GAS-COOLED REACTORS. László Perneczky. Energia Atomtech., 15: 375-80(Aug. 1962). (In Hungarian)

30970 FAST REACTORS IN THE EUROPEAN COMMUNITY. Jules Guéron. Euratom Bull., No. 2, 2-7(June 1964).

Development of fast reactors in the European Community is discussed. The RAPSODIE program, research and development on the design of future fast power reactors, physics experiment facilities, and general research support are described. (M.C.G.)

30971 THE DEVELOPMENT OF GRAPHITE-MODERATED, GAS-COOLED, HIGH TEMPERATURE REACTORS WITH PRISMATIC CORES. E. Boehm and H. Voelcker (Gutehoffnungshutte Sterkrade Aktiengesellschaft, Oberhausen, Ger.). Kerntechnik, 6: 203-9(May 1964). (In German)

A survey was made of the development of graphite-moderated, gas-cooled, high-temperature reactors. Characteristics of the reactor concept are: a metal-free core, the use of graphite as a structural material, fuel matrix, and canning material for the fuel element; the semi-homogeneous dilution of fuel in the moderator; and an internal purge gas stream for the removing of fission products. The OECD reactor experiment Dragon and the prototype reactor plant of General Atomic's HTGR are described. Development capabilities of this reactor system are discussed. (auth)

Fuels

Refer also to abstracts 30490, 30497, and 30503.

30972 (BLG-222) VARMO I—A ONE-DIMENSIONAL BURNUP PROGRAMME FOR A TWO DRUM MERCURY COMPUTER. R. De Meersman and F. de Waegh (Centre d'Etude l'Energie Nucleaire, Brussels). Mar. 1963. 36p.

VARMO I is a one-dimensional three-group burnup program for plane, cylindrical, or spherical geometry. It is intended primarily for variable moderation reactors in which reactivity changes are compensated by light-water dilution of a $H_2O–D_2O$ moderator and coolant. VARMO I may also be used for the calculation of reactors in which reactivity is controlled by burnable poisons, soluble poisons, or absorbing rods. If necessary, the program can be used for the calculation of resonance integrals and three-group macroscopic cross sections. (auth)

30973 (HW-76304(p.3.1-19)) FUELS DEVELOPMENT. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

End cap welds in beryllium-clad fuel elements was made. Current welds are subject to small longitudinal microcracks. Several improvements and innovations were made in the magnetic force welding machine. Fabrication process changes were made to improve the performance of PRTR fuel elements. These improvements were incorporated in the fabrication of UO_2–1 wt % PuO_2 swaged and vibrationally compacted 19-rod clusters. Three general types of tungsten tubing are available. Spark discharge machined tubing gives good grain structure in small diameters. Most vapor-deposited tubing had a wall thickness of one grain. A centrifugal hone was developed to remove internal burrs from EBWR cladding tubes. Fabrication of $UO_2–PuO_2$ fuel rods for the EBWR was started, using new vibratory compaction equipment. Differences within and between lots of impacted $UO_2–PuO_2$ powder are being examined to determine optimum compactibility. Study of 4-in.-diameter impaction cans for plutonium-bearing compounds was continued to provide a design optimized for safety with reasonable economy. Multiple impaction of PuO_2–SS cermet pellets to 97% TD was accomplished by a split die technique. Several samples of different size fractions of UO_2 and $UO_2–PuO_2$ mixtures were pneumatically impacted for a variety of uses. Preliminary experiments in pneumatic impaction of thorium oxide were performed. Specification documents were drafted for swage-compacted and vibrationally compacted $UO_2–PuO_2$ Mark-I PRTR fuel elements. Tests were made to establish the control procedures necessary to ensure that oxide fuel does not contain excessive moisture when it is loaded into fuel rods. Assembly of eddy current coils into fuel rods is in progress as part of a program to measure relative motion between PRTR Mark-I elements and process tubes. Very little wear occurred on the ring support of a Mark-I fuel element. However, slight hydriding (100 to 200 ppm) was detected in worn areas. Tungsten–UO_2 cermet platelets with a tungsten metal cladding were made by impaction. Bonding appeared to be aided by using a hydrogen purge before impaction. A fuel rod was rejuvenated twice and completed three radiation cycles in the MTR. Two PRTR fuel elements which had received some reactor exposure were repaired and returned to the reactor. Six plutonium bearing physics experimental test elements were fabricated. (auth)

30974 (HW-76304(p.4.1-40)) FUELS TESTING AND ANALYSIS. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The general condition of swaged and vibrationally compacted $UO_2–PuO_2$ fuel elements continues to be excellent up to the exposure of 1.1×10^{20} fissions/cc (3960 Mwd/ton). High resolution autoradiographs of irradiated, high-energy-impacted $UO_2–PuO_2$ reveal the distribution of PuO_2 in swage-compacted and vibrationally compacted elements. Capsules containing vibrationally compacted, impacted UO_2–2.5 wt % PuO_2 and physically mixed UO_2–2.5 wt % PuO_2 continue irradiation in the ETR. Goal exposure is 1.43×10^{20} fissions/cm^3 (5000 Mwd/ton of fuel). Irradiated $UO_2–PuO_2$ pellets show significant migration of ^{137}Cs and ^{106}Ru and insignificant migration of Pu, $^{95}Zr–^{95}Nb$, $^{144}Ce–^{144}Pr$, and ^{90}Sr. Marked concentration gradients of some fission products ($^{95}Zr–^{95}Nb$, ^{137}Cs, ^{90}Sr, and ^{106}Ru) occurred near (0.03 cm or 0.01 in.) the fuel surface. Post-irradiation examinations of vibrationally compacted $UO_2–PuO_2$ PRTR fuel rods support the hypothesis that failures were caused by gas-phase hydriding on the inner surface of the Zircaloy cladding. Brittle circumferential cracks in cladding of swage-compacted $UO_2–PuO_2$ PRTR fuel rods are attributed to the presence of contaminants in the fuel. A swage-compacted UO_2 PRTR fuel rod developed an ex-

tensive longitudinal cladding split from a previously nondiscernible defect during extended residence (2 yr) in the basin water. Eighteen prototypic PRTR fuel capsules containing UO_2–1 wt % PuO_2 contaminated with known quantities of water and oil were discharged from the MTR after 1 cycle of irradiation. UN–W and UN–Mo cermets were chemically and dimensionally stable during 21 days irradiation at cladding surface temperatures greater than 2000°C. No degradation of the irradiated UN was observed during polishing of ceramographic specimens with a water-base abrasive slurry. Further confirmation that the once-molten zone in irradiated UO_2 extends to the outer edge of the subgrain structure region within the columnar grains was provided by examining irradiated UO_2 pellets that initially contained small randomly dispersed tungsten spheres. A fuel element containing naturally enriched UO_2 pellets with a coaxial Pu–15 wt % Zr alloy wire was successfully irradiated to an exposure of 2×10^{19} fissions/cc (680 Mwd/ton fuel) at a maximum surface heat flux of 122 w/cm^2 (385,000 Btu/(hr)(ft^2)). Three aluminum-clad, compacted-powder thoria elements were irradiated for 1 cycle in the MTR. Five $(Th,Pu)O_2$ capsules were successfully irradiated to 0.5 to 0.84 $\times 10^{20}$ fissions/cc. A molten UO_2 fuel rod that generated 2.42 kw/cm was discharged after an exposure of 1.23×10^{20} fissions/cc. (auth)

30975 (LAMS-3096) PLUTONIUM REACTOR FUEL DEVELOPMENT. Quarterly Status Report for Period Ending May 20, 1964. (Los Alamos Scientific Lab., N. Mex.). June 1964. Contract W-7405-eng-36. 14p.

The disassembly and post-mortem examination of LAMPRE cores and fuel capsules are reported. Information is also included on: computer codes for analysis of radioisotopes in LAMPRE capsules, corrosion of tantalum and yttrium by plutonium fuels, shielding calculations, development and construction of Core Test Facility, and phase studies of plutonium–scandium and cerium–nickel alloys. (N.W.R.)

30976 (ORNL-TM-811) FABRICATION AND PRE-IRRADIATION DATA FOR HIGH FLUX ISOTOPE REACTOR PROTOTYPE TARGET RODS. J. D. Sease and D. M. Hewette, II (Oak Ridge National Lab., Tenn.). June 1964. Contract W-7405-eng-26. 31p.

To assist in an evaluation of the adequacy of the High Flux Isotope Reactor target element design, four prototype irradiation samples are irradiated in the Engineering Test Reactor. The $\frac{3}{8}$-in.-diam aluminum-clad elements, which are slightly shorter than the proposed HFIR target elements, are $24\frac{1}{2}$ in. long and contain $14\frac{1}{4}$ in. of fueled length, which is composed of aluminum-jacketed $^{239}PuO_2$–Al dispersion pellets (approximately 14 vol % PuO_2). The fabrication of the four irradiation prototype elements along with two control elements consisted of pressing of aluminum-jacketed PuO_2–Al dispersion pellets; loading of pellets into fuel rod; welding of end cap; hydrostatic collapse of clad onto pellets; and attachment of spacing can be finned clad tubing. A description of the fabrication procedures and complete preirradiation data and photographs are presented. (auth)

30977 (EURAEC-1016) NUCLEAR VAPOTRON. Quarterly Report No. 6, July–September 1963. (Compagnie Francaise Thomson-Houston, Paris; Societe Alsthom, Paris; and Allgemeine Elektrizitatsgesellschaft, Frankfurt am Main). Work Performed under United States–Euratom Joint Research and Development Program. Contract 050-62-5 RDC. 15p. (A translation).

The "nuclear vapotron" is a reactor fuel canning with irregular (e.g., gear-toothed, serrated, etc.) cross section, whose purpose is the stabilization of boiling heat transfer along the can surface. Studies on the optimization of the cross-sectional dimensions of vapotron elements are reported. The design of a test facility for vapotron elements is also described. (T.F.H.)

30978 SUCCESSFUL DEVELOPMENT OF NEW FUEL PARTICLES. K. Diebner. Kerntechnik, 6: 215-16(May 1964). (In German)

Fuel development for high-temperature gas-cooled reactors is discussed. The goal of this development is improving the retention of the fission products in the fuel element body without a metal cladding. Properties of coated particles were studied. Aluminum and beryllium oxides were considered as coating materials for uranium oxide and uranium carbide particles. (M.C.G.)

30979 THE VALUE OF PLUTONIUM. E. N. Shaw. Neue Tech., 6: 129-31(June 1964).

As the problems of plutonium technology became better understood, the book value ascribed to plutonium tended to zero. In a balanced nuclear economy where bred plutonium is used to fuel fast reactors, it was concluded that the fuel value may be based on an assumption of equal power costs from thermal and fast reactor stations. A simplified calculation indicated the real credit value of plutonium to be equivalent to about 0.6 to 0.7 mill/kwh in Magnox reactors. (auth)

Power and Power-Breeder Reactors

Refer also to abstracts 30095 and 30474.

30980 (ACNP-64011) PATHFINDER ATOMIC POWER PLANT. BOILER FUEL ROD VIBRATION TEST. D. A. Patterson and W. J. Severson (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). June 22, 1964. For Northern States Power Co., Minneapolis and Central Utilities Atomic Power Associates. Contract AT(11-1)-589. 31p.

Two simulated Pathfinder boiler fuel elements were tested in an air-water loop to study their vibrational characteristics under parallel two-phase flow. The rods were lead-filled stainless steel tubes with an outside diameter of 0.375 inches and a wall thickness of 0.020 inches and were fitted with stainless steel end caps. One rod was 36.23 inches long supported at the ends only, and the other rod was composed of two sections, each approximately 18.25 inches long, supported at the ends and at the joint between the two sections. Strain gage signals from the vibrating rods were recorded for flow velocities ranging from 15 to 30 fps and for void content from 0 to 60 per cent. (auth)

30981 (AD-429034) A HUMAN ENGINEERING EVALUATION OF THE ML-1 AND ML-1A MOBILE LOW POWER NUCLEAR POWER PLANT. Technical Memorandum 19-63. B. Lawrence Sova, Jr., Marlin E. McCahan, and Richard H. Dewey (Army Human Engineering Labs., Aberdeen Proving Ground, Md.). Oct. 1963. 115p.

Evaluation of the ML-1 Mobile Nuclear Power Plant from 1 April 1962 to 30 April 1963 is reported, and includes a simultaneous task analysis of the ML-1 startup procedures a review of the layout and operation of the reactor, power conversion skid, and gas storage skid, the monitoring of the contractor's product improvement program, a proposed layout of the ML-1A control cab, and a review of the train-

ing-simulator design. Recommendations are made for improving the operation and maintenance of this system. A description of the reactor plant is included. (auth)

30982 (CVNA-206) MONTHLY OPERATING REPORT, MAY 1964. (Carolinas Virginia Nuclear Power Associates, Inc., Parr, S. C.). Contract [AT(30-1)-2289]. 35p.

Major systems and controls were set up for automatic control under actual operating conditions in preparation for the reactor transient and load rejection tests. The CVTR achieved full licensed power of 44.3 Mw(t), ~ 10.5 Mw(e). The following tests were run and successfully performed: transient tests without automatic control, transient tests for evaluation of automatic control system, load rejection tests, and automatic control system setpoint adjustment. The reactor was operated continuously from May 6 to 26, 1964, when the reactor was shutdown for a period of 12 hours to remove accumulated soot from the air preheater on the superheater. The gross electrical generation for the month was 5,648,000 kwh. (auth)

30983 (DPR/INF/274) THE STEAM GENERATING HEAVY WATER PROTOTYPE REACTOR. A. Firth, N. Bradley, and J. E. R. Holmes (United Kingdom Atomic Energy Authority, London). Apr. 1964. 4p.

Some preliminary concepts are given for the design and construction of a prototype steam-generating, heavy-water-moderated reactor with an output of 100 Mw(e). (R.E.U.)

30984 (EUR-1811.n) KERNENERGIECENTRALE NAAMLOZE VENNOOTSCHAP SAMANWERKENDE ELECTRICITEITS-PRODUCTIEBEDRIJVEN (N. V. SEP) JAARVERSLAG 1963. (Nuclear Power Plant "Naamloze Vennootschap Electriciteits-Productiebedrijven (N. V. SEP)" Annual Report, 1963 . (Samenwerkende Electriciteits-Productiebedrijven, N. V., Arnhem, Netherlands). 1964. 44p.

The engineering, economic, and construction status of the N. V. SEP Reactor, which is a 50-Mwe, boiling-water-cooled, water-moderated power plant, is outlined. (T.F.H.)

30985 (GA-4786) 40-MW(E) PROTOTYPE HIGH-TEMPERATURE GAS-COOLED REACTOR RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report for the Period Ending June 30, 1963. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Contract AT(04-3)-314. 18p.

The development of the Peach Bottom Power Reactor is discussed. Information is given on the development of reactor core and reflector, transport theory source calculation, critical assembly calculations, startup and postconstruction physics tests, fuel element handling, instrumentation of fuel elements, O-ring seal testing, fission-product analysis of GAIL III-A fuel bodies, and corrosion of Inconel by iodine, cesium iodide, and silver iodide at 400°C in helium. (N.W.R.)

30986 (GAMD-4526) SHIELDING STUDIES FOR TARGET REACTOR. B. A. Engholm (General Atomic Div. General Dynamics Corp., San Diego, Calif.). May 1, 1964. Contract AT(04-3)-167. 47p.

Shielding analysis of the TARGET reactor concept has been limited to those problem areas in which the feasibility of the system or key subsystems might be in question. Areas investigated include the fast-neutron flux incident upon the vessel liner, nuclear heating in the side and top regions of the reactor, neutron activation of the circulator, radiation dosage to the gas-turbine lube system, and biological dose rates external to the vessel. Neutron and gamma fluxes and heating rates were calculated for the side regions of the TARGET reactor using an extensive series of IBM-7090 codes. Infinite-slab geometry was used, and attenuation provided by circulators and steam generators was ignored. Core power density was taken as 6.7 w/cm^3 and the relative power at the side as 1.0. (auth)

30987 (IDO-28526) GAS-COOLED REACTOR EXPERIMENT. Semiannual Progress Report, January 1–June 30, 1958. (Aerojet-General Nucleonics, San Ramon, Calif.). Oct. 17, 1958. Contract [AT(10-1)-880]. 138p.

The organization, experiments, and work progress of the Gas Cooled Reactor Experiment (GCRE) is reviewed. This report is divided into sections on: architect-engineering services; fuel element development and fabrication; material development; experimental heat transfer; reactor instrumentation; reactor design and development; and nuclear experiments. (auth)

30988 (NAA-SR-6920) COOLANT DECOMPOSITION RATES AND MAKEUP COSTS FOR ORGANIC REACTORS. R. H. J. Gercke and J. F. Zack, Jr. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). June 15, 1964. Contract AT-11-1-GEN-8. 42p.

Summarized are the results of several recent experimental programs conducted to evaluate the effect of fission neutrons on terphenyl coolant and establish differences between decomposition rates due to fast neutrons and gamma rays. Interpretation of these results indicates that, at 600°F, fast neutrons are approximately 4.4 ± 0.5 times more damaging than gamma rays for the same amount of radiation energy deposited. It is also indicated that the "fast neutron effect" increases with temperature. New techniques for calculation of radiation energy absorption in organic reactors have been applied to three large Organic Moderated and Cooled central station power plant designs as well as to the OMRE and PNPF (Piqua). Coolant makeup rates and costs are calculated. Based on a coolant cost of $0.17/lb, the overall coolant makeup costs for these power reactors are 0.56 to 0.83 mill/kwhe, depending on the particular reactor design. (auth)

30989 (NAA-SR-8579) ANALOG MODELS FOR HNPF CONTROL AND PROTECTION STUDIES. C. L. Dunsmore, ed. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). June 15, 1964. Contract AT-11-1-GEN-8. 69p.

The report, intended as a working document, contains analytic representations and analog models of the Hallam Nuclear Power Facility as used in studies of the Control and Protection Systems. Useful equations and computer connection diagrams are provided for the guidance of workings in the general field of reactor control and protection. (auth)

30990 (NAA-SR-9717) OPERATING EXPERIENCE WITH HEAT-TRANSFER-SYSTEM PUMPS AT THE HALLAM NUCLEAR POWER FACILITY. R. E. Durand (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). June 15, 1964. Contract AT-11-1-GEN-8. 25p. (CONF-258-3)

From Sodium Components Development Program Information Meeting, Palo Alto, Calif., Aug. 1963.

At the Hallam Nuclear Power Facility (HNPF) six centrifugal, overhung, free-surface pumps are used to circulate sodium in the heat transfer system for the purpose of transferring heat from the reactor to the steam generators. These pumps, which have been in operation since March, 1962, have required maintenance and minor modifications to assure satisfactory operation. The operating and maintenance experience obtained at HNPF on the sodium heat transfer pumps is described. (auth)

30991 (ORNL-3619) GAS-COOLED REACTOR PROGRAM. Semiannual Progress Report for Period Ending March 31, 1964. (Oak Ridge National Lab., Tenn.). July 1964. Contract W-7405-eng-26. 397p.

The report contains eleven sections, each of which is abstracted separately. (T.F.H.)

For abstracts of individual sections see: 29843, 30115, 30116, 30153, 30952, 30953, 30954, 30992, 30993, 30994, and 30995.

30992 (ORNL-3619(p.3-11)) PERFORMANCE ANALYSES. A. M. Perry (Oak Ridge National Lab., Tenn.).

A study was made of the effect of the energy of extraneous source neutrons on the amplitudes of higher modes in the flux distribution of a subcritical reactor. It was found that the higher modes could be greatly suppressed if the energies of the extraneous neutrons were sufficiently higher than those of the fission source neutrons. This reduction is important in the case of source-jerk experiments with a 14-Mev neutron source and is only nominal for the case of a polonium-beryllium source. The accuracy of an importance function for reactivity proportional to the square of the power was studied for the EGCR. For axial perturbations this function was found to be essentially identical to the exact importance function. (auth)

30993 (ORNL-3619(p.12-23)) COMPONENT DEVELOPMENT AND TESTING. H. W. Savage and A. Goldman (Oak Ridge National Lab., Tenn.).

Attempts are made to run aerodynamic performance tests on the main coolant blowers for the EGCR. Modifications were required both to the shaft and to the bushing retainer of the atmospheric seal. The tests show that replating of the shaft with chromium will be required. A graphite sleeve of the type to be used in the EGCR assembly fuel was tested in the experimental facility for studying the reaction of graphite and steam under simulated reactor operating conditions. Data obtained while varying the system pressure and holding the graphite temperature approximately constant showed that the volume of hydrogen formed per unit of carbon reacted increased with system pressure increases. Stress-rupture tests of EGCR type 304 stainless steel fuel tubing were concluded. There appeared to be no difference in the strength of the two heats tested. No apparent difference in behavior was noted in air and in flowing argon. No abnormal grain growth was observed at 1800°F. The maximum tangential strains at fracture of 5 to 20% were measured. The dimensional stability of EGCR pneumatic temperature-measuring nozzles is being studied. The nitrided type 304 stainless steel nozzles had significant increases in throat diameter after 200 hr in helium at 1050°F. The 400-, 600-, and 800-hr readings indicated a gradual return to normal diameters. (auth)

30994 (ORNL-3619(p.201-77)) DEVELOPMENT STUDIES FOR AVR—GERMAN PEBBLE-BED REACTOR. A. Goldman, W. O. Harms, O. Sisman, and D. B. Trauger (Oak Ridge National Lab., Tenn.).

A summary is presented of design, radiation-testing, and results of post-irradiation examination of fuel elements for the BBC-Krupp AVR Reactor. (T.F.H.)

30995 (ORNL-3619(p.278-335)) STUDIES OF ADVANCED SYSTEMS. M. Bender, B. L. Greenstreet, A. M. Perry, and G. Samuels (Oak Ridge National Lab., Tenn.).

Studies are carried out on the design, fuel cycles, and thermal performance of fast gas-cooled reactors fueled with UO_2-PuO_2 mixtures. The coolants considered include CO_2, SO_2, and He. The design of a steam generator for such a reactor is also investigated. The radiation stability of CF_4, a possible alternate coolant, is determined. Nozzle-to-shell attachments and decontamination of fast GCR's are discussed. (T.F.H.)

30996 (RT/ING(64)-4) A PROPOSED HOT LABORATORY FOR THE EXAMINATION OF THE LATINA-TYPE FUEL ELEMENTS. C. Cesarano, M. Lauro, and G. Testa (Italy. Comitato Nazionale per l'Energia Nucleari, Rome). Feb. 1964. 15p.

The statistical examination of fuel elements affords an important means of information and improvement of the fuel element performance under long-term irradiation. A hot laboratory is required to carry out such examination and special attention should be paid to both the examination program and the maintenance of the plant. The program to be performed in such a plant consists of routine tests, and it is very important that breaks be as short as possible; therefore it is necessary to reduce to a minimum the time required for maintenance. The above-mentioned criteria have led to a preliminary design which is briefly described. The British experience in this sector was especially taken in consideration. (auth)

30997 (SL-1954) CAPITAL COST EVALUATION [OF] 1000-MWe MOLTEN SALT CONVERTER REACTOR POWER PLANTS. (Sargent and Lundy, Chicago). June 29, 1962. Includes Appendix A: MOLTEN SALT CONVERTER REACTOR CYCLES AND PRIMARY SYSTEMS. L. Alexander, D. Janney, R. Robertson, J. Westsik, and R. Van Winkle (Oak Ridge National Lab., Tenn.). For Oak Ridge National Lab., Tenn. Contract [W-7405-eng-26], [Subcontract 2086]. 239p.

The results are presented of a conceptual design and capital cost estimate of three variations of the molten salt-cooled power reactor cycle, each of sufficient capacity to develop approximately 1000 Mw(e). A mixture of fluorides of lithium, beryllium, uranium, and thorium serves as the transport medium for the reactor fuel in each case, and the three concepts include a binary vapor cycle using mercury and steam turbines, an indirect power removal cycle that uses a nonfuel-bearing salt mixture as an intermediate coolant, and a direct power removal cycle in which the fuel salt transfers its heat to boiling water and steam in a system of heat exchangers. The cost estimates include all primary and intermediate coolant heat exchangers, the major steam cycle components, turbine plant auxiliaries, and the buildings required to house the reactor and turbine plant and the turbine auxiliaries. The power plants and associated auxiliaries are described. A description of the primary and intermediate heat transfer systems, which was prepared by ORNL as the basis of plant designs and estimates, is presented. (R.E.U.)

30998 (SRO-102) POWER REACTOR DEVELOPMENT ACTIVITIES. Monthly Progress Report, May 1964. (Savannah River Operations Office, AEC). 11p.

A summary is presented of studies of creep-rupture in SAP-895, design studies of a 1000-Mw(e) Th-fueled heavy-water power reactor, and operations of HWCTR and CVTR. (T.F.H.)

30999 (SwRI-1228-21) EVALUATION OF THE SERVICEABILITY OF THE ELK RIVER REACTOR PRESSURE VESSEL. Progress Report No. 5, February 1, 1964–March 31, 1964. Jose McDonald, Jr., Kenneth K. Spiers, and Allen R. Whiting (Southwest Research Inst., San Antonio). June 2, 1964. Contract AT(11-1)-1228. 21p.

The serviceability of the pressure vessel for the Elk River Power Reactor is analyzed, by determining the effects of fabrication history, dissimilar welds, and irradia-

tion on the nil-ductility transition temperature and fatigue properties of the completed vessel. (T.F.H.)

31000 (TID-20808) GARIGLIANO NUCLEAR POWER PLANT. Progress Report for the First Quarter of 1964. Technical Report, Mar. 31, 1964. (Società Elettronucleare Nazionale, Rome). 6p.

The operation of the Garigliano power plant and the difficulties encountered are described. The turbine HP shaft was repaired during shutdown, and the causes of the turbine overspeed were studied. The condenser design was modified, and the Monel-K bolts on the primary circuit valves had to be replaced by AISI-4140 Cr–Mo steel bolts. (D.L.C.)

31001 (TID-20700) ARDENNES NUCLEAR POWER PLANT. SUMMARY. I. DESIGN STUDIES. II. PREFABRICATED COMPONENTS. III. ON-SITE WORKS. Quarterly Report No. 6, October 1–December 31, 1963. (Société d'Énergie Nucleaire Franco-Belge des Ardennes, Chooz-lez-Givet, France). Jan. 22, 1964. Work Performed under United States–Euratom Joint Research and Development Program. 48p. (A translation)

A review is given of progress in the civil engineering, nuclear and conventional design, procurement and design of prefabricated components, and on-site construction for the Ardennes Nuclear Power Plant. (T.F.H.)

31002 WATER STEAM FOR REACTOR COOLANT. B. Polock. Atomkernenergie, 9: 171-80(May-June 1964). (In German)

The reactor-cooling qualities of different gases such as nitrogen, carbon dioxide, and helium with the help of a specific heat exchanger or by some other means are discussed. Superheated steam was also studied. It was discovered that cooling a reactor by managing it as an exclusively steam heater diminishes the power consumed for circulation and gives a higher output of nuclear energy for the reactor. At a high pressure level it is possible to cool a fast reactor by means of steam, as well as by metallic fluids. The process of producing steam by indirect heating (Löffler system) allows use of a nuclear power plant with the highest level possible of initial steam pressure, with a high initial steam temperature and a somewhat higher reheat steam temperature. The cooling steam in the reactor may have a moderate pressure level. For cooling a fast reactor by high-pressure steam a recompression steam system is described. (auth)

31003 NUCLEAR POWER PLANT INSTRUMENTATION. F. C. Faught, Jr. (Knolls Atomic Power Lab., Schenectady, N. Y.). Elec. Eng., 6p.(Dec. 1957). (KAPL-P-1861)

Rapid advances have taken place in nuclear-power-plant instrumentation. The power plant systems and detector requirements and designs are studied, because it is in these areas that the major differences exist between conventional and nuclear power plants. (auth)

31004 ECONOMIC COMPARISON OF NUCLEAR POWER PLANT SYSTEMS. J. Gaussens. Energie Nucl., 6: No. 2, 65-73(Mar.-Apr. 1964). (In French)

The choice of equipment for the production of electricity is more difficult for nuclear power plants than for classical installations, principally because of the more rapid technical and economic evolution and the importance of capital costs in the nuclear field, which obliges the choice of a system for a series of power plants and not only for an isolated one. The data available are not sufficient for judging the technical and economical aspects of each system and many uncertainties exist; from the economic point of view alone, there is the effect of expenses on the cost of the kilowatthour, the price of the fuel (which is a function of the undetermined value of plutonium), and of the fuel cycle (which is more or less complex depending on the system). Criteria other than the cost of the kilowatthour come into play in the nuclear field. (auth)

31005 FUEL FOR THE "ZENITH" REACTOR. D. George and C. C. H. Wheatley (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nucl. Energy, Pt. A & B, 18: 233-9(May 1964).

The development and production of fuel for the high-temperature zero-energy reactor Zenith is described and some features associated with the substitution of ^{233}U for ^{235}U are reported. (auth)

31006 DEVELOPMENT AND TESTING OF THE QUENCH TANKS FOR THE HIGH TEMPERATURE REACTOR DRAGON. H. Uschwa and M. Krueger (Borsig AG, Berlin). Kerntechnik, 6: 210-12(May 1964). (In German)

The duty and design of the quench tanks in the heat-removal system of the Dragon Reactor are described. Information is given about results of test series carried out with different discharge systems. (auth)

31007 THERMIC DEVELOPMENT WORK FOR A HIGH TEMPERATURE REACTOR SYSTEM. P. V. Gilli (Waagner-Biro AG, Vienna). Kerntechnik, 6: 213-15(May 1964). (In German)

Heat exchangers and heat transfer means in gas-cooled high-temperature reactors are discussed. The steam generators (primary heat exchangers) of the Dragon Reactor are described. (M.C.G.)

31008 CONTROL RODS AND CONTROL ROD DRIVES FOR THE HTGR-DRAGON. Kerntechnik, 6: 216-17(May 1964). (In German)

The designs of control rods and control-rod drives for the Dragon Reactor are described and diagrams given. (M.C.G.)

31009 THE TECHNIQUE OF DISMANTLING CONTAMINATED PARTS AT THE BBC/KRUPP REACTOR. H. Braun. Kerntechnik, 6: 266-8(June 1964). (In German)

Two systems of disassembly techniques used for the BBC-KRUPP High-Temperature Reactor are described. These two systems are for disassembly of the circulation system parts with closed pressure and density shells and for disassembly of the various parts outside the shell. (M.C.G.)

31010 COMPARISON OF NUCLEAR WITH CONVENTIONAL ENERGY PRODUCTION. R. Guck. Neue Tech., 6: 118-28(June 1964). (In German)

It was concluded that under the given circumstances, large nuclear power plants can be competitive only if they take over an extensive base load. In any case, nuclear power plants of smaller installed capacity (less than 50 Mw) are not considered economical since usually they are constructed to function as pilot plants for other reasons than that of an economic energy production. The power plants of medium installed capacity belong to the transition region. Technical-economical fundamentals are outlined. The future of energy supply in Switzerland is discussed. (auth)

31011 HEAVY WATER REACTOR RESEARCH IN BRITAIN. E. N. Shaw. Neue Tech., 6: 137-40(June 1964).

The steam-generating heavy-water reactor, which is being built at Winfrith, is a boiling-water pressure-tube reactor in which heavy water acts as the moderator and light water or steam as coolant. The reactor is seen as a

power prototype, which will furnish experience on aspects of water reactor technology. (auth)

31012 TEMPERATURE OF JPDR FUEL AT LOSS-OF-COOLANT ACCIDENT. Yasumasa Togo (Tokyo Univ.) and Yoshihide Yamazaki. Nippon Genshiryoku Gakkaishi, 6: 211-17(Apr. 1964). (In Japanese)

Calculations were made of JPDR fuel temperature in a loss-of-coolant accident. At the accident, the reactor is scrammed either by a low-reactor-water-level signal or by a high-enclosure-pressure signal, and the core spray system is initiated. In analyses, a fuel rod and clad were divided into six and two annulus sections, respectively. Various cases with and without control rods and a core spray system in operation were evaluated. In evaluation of a case without a core spray system in operation, axial heat conduction in UO_2 was neglected before radial temperature distribution was flattened and after that, radial heat conduction was neglected to calculate axial temperature distribution. (auth)

31013 A NUCLEONICS SURVEY—ECONOMIC AND TECHNICAL DATE FOR MAJOR U. S. POWER REACTORS. Nucleonics, 22: No. 7, 56-9(July 1964).

Economic and technical data on the major reactors in operation, construction, or planning are compiled. (D.C.W.)

31014 ANALYZING POWER COSTS FOR NUCLEAR PLANTS. L. Geller, J. F. Hogerton, Jr., and S. M. Stoller (S. M. Stoller Associates, New York). Nucleonics, 22: No. 7, 64-72(July 1964).

The economic analysis by which utilities determine the advisability of switching to nuclear power is outlined to illustrate the bases for the variations in the cost projections developed by different utilities for similar plants and to indicate the extent to which these variations are based on hard fact. (D.C.W.)

31015 YANKEE REACTOR INSTRUMENTATION OPERATION AND MAINTENANCE HISTORY. David A. Hansen, Jr. (Yankee Atomic Electric Co., Rowe, Mass.). 8p. (CONF-401-6)

From Institute of Electrical and Electronics Engineers 1964 International Convention, New York, Mar. 1964.

The instrumentation and controls required for the operation of the Yankee reactor and primary plant are described, and the operation and maintenance history of this instrumentation is followed from initial installation and testing of the equipment through the operation of the first and second reactor cores. Descriptions and histories are given for the primary plant pressure, temperature, level, and flow channels; the nuclear instrumentation source, intermediate, and power range channels; and the in-core flux wire and thermocouple channels. The educational backgrounds and training experience of the personnel required to perform routine and preventive maintenance on Yankee instrumentation are outlined. (auth)

Production Reactors

31016 (HW-79616) TECHNICAL PROBLEMS IN FITTINGS FOR N-REACTOR PRIMARY LOOP. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 1963. Contract AT(45-1)-1350. 36p.

In N-Reactor, a joint that would meet rigorous mechanical and thermal requirements was needed between the zirconium alloy process tubes and the carbon-steel nozzles. Nine types were tested and a rolled joint was selected on the basis of strength and minimum leakage. For this type of joint, the metal of the tube is rolled and expanded into the grooved cylindrical inner surface of the nozzle. Quick make- and break connector couplings are needed in the N-Reactor to joint nozzles, inlet or diversion valves, and manifold connectors. Fifteen variations or combinations of basic coupling designs were evaluated, and a Graylock coupling selected on the basis of ruggedness, leakage resistance, and freedom of collection pockets for radioactive particulates. Improvements were made in the geometry of the bearing surface between the studs and the forgings, in the use of rolled threads with generous root radius, and in the use of temporary shims during assembly to minimize stresses. Each of the connectors carrying coolant to the process tubes contains a venturi throat for monitoring flow. An insert was fabricated for this purpose, but when the assembly was stress relieved in the liner deformed in compression and became loose. Modifications consisted of substituting Inconel for stainless steel inserts, and deepening the throat tap to effect some additional restraint. Prototypes have met all design requirements and tests. N-Reactor has over 2000 fabricated manifold connectors joining the tube nozzles to the inlet and outlet headers. Problems were encountered in the procurement of tubing for these connectors with normalized metal that, after fabrication and stress relieving would exhibit specified impact strengths. Parameters were established for the duration and temperature of normalizing treatment for full transformation recrystallization. Tests have verified that tubing normalized at these values meet the specified metallurgical requirements. The impact strength of valves and fittings for N-Reactor high pressure primary loop was specified using V-notch Charpy tests. The impact or tensile strengths of some groups of valve body forgings after usual forging and heat treating did not meet specifications. Procedures were established reducing the quench time at transformation temperature and increasing the maximum rate for cooling of tempering and stress relieving. This heat-treatment procedure has given consistently good results. (auth)

Propulsion and Space

Refer also to abstracts 29844 and 29923.

31017 (DC-60-8-58) ESTIMATED PHOTONEUTRON POWER LEVELS FOR THE D-140-E1 REACTOR. J. K. Baker (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Aug. 9, 1960. Contract [AT(11-1)-171]. 9p.

A series of curves showing the estimated photoneutron power level in the D-140-E1 reactor after any operating history are shown for shutdown times of up to 2.15×10^6 seconds (25 days). (auth)

31018 (EUR-1621.e) TECHNICAL SAFETY EVALUATION OF THE N.S. SAVANNAH. (European Atomic Energy Community; Bureau Veritas, S. A., Paris; and Germanischer Lloyd, Hamburg). Oct. 1961. 276p.

A safety evaluation of the N.S. Savannah drawn up by Euratom, the Bureau Veritas, and Germanischer Lloyd is presented. (R.E.U.)

31019 (IDO-16825) SAFETY ANALYSIS REPORT—SNAPTRAN 2/10A-1 SAFETY TESTS. F. L. Bentzen (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho) and R. L. Detterman, et al. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). J. M. Waage, ed. Jan. 28, 1963. Contract AT(10-1)-205. 243p.

The broad objectives of the test program are to demon-

strate and determine the consequences of nuclear accidents approximating the maximum credible and to provide information regarding the characteristics of the SNAP 2/10A reactor of importance to evaluating and predicting the behavior of the reactor with respect to nuclear safety. The initial test series, designated as SNAPTRAN 2/10A-1, is aimed at providing a portion of the information needed to attain these objectives. This test series is directed at providing safety information on the beryllium reflected SNAP 2/10A reactor in an atmospheric environment. The flight reactor was modified to permit rapid reactivity addition for the safety tests. The experimental program includes reactor kinetic tests aimed at measuring the dynamic coefficients of the reactor, static physics measurements essential to interpretation of kinetic test results, and a nuclear excursion approaching the maximum credible. The potential hazards of conducting the experimental program were evaluated, and the results of the safety analysis are presented. A brief description of the experimental program, a description of the reactor test package and control system, a description of the test site and facilities, a discussion of the operating philosophy and test procedures, and an evaluation of the potential hazards attendant to the experimental program are presented. The areas of consideration in this evaluation include materials handling and control, possible operator error and system failure, radiological hazards associated with the static and nondestructive kinetics tests, and the consequences of the destructive test. On the basis of the safety analysis studies conducted, it was concluded that the test program can be conducted without hazard to operating personnel or the general public. (auth)

31020 (NAA-SR-Memo-8215(Pt.8)) SNAP (SYSTEMS FOR NUCLEAR AUXILIARY POWER) TECHNICAL BRIEFS. PART 8. AEROSPACE SAFETY. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Feb. 21, 1963. Contract AT(11-1)-Gen-8. 31p.

The objectives of the Atomics International Aerospace Safety Program are reviewed and the current program is discussed. Potential hazards and the inherent safety of SNAP 10A, 8, and 2 are considered under project titles such as critical configuration tests, mechanical and thermochemical effects, reactor transients and excursion tests, fission-product release studies, reactor end-of-life shutdown devices, reactor separation and fuel element ejection, and fuel element burnup and fission product dispersal. (R.E.U.)

31021 (SC-RR-64-511) RE-ENTRY FLIGHT DEMONSTRATION NUMBER ONE (RFD-1): DESIGN, DEVELOPMENT, AND PERFORMANCE OF THE RE-ENTRY VEHICLE. C. E. Erickson, H. C. Hardee, J. I. Hegge, J. Jacobs, S. L. Jeffers, R. D. Klett, H. R. Spahr, H. K. Togami, I. B. White, and G. Q. Wilson (Sandia Corp., Albuquerque, N. Mex.). May 1964. Contract [AT(29-1)-789]. 150p.

The design, development, and performance of the flight vehicle for Reentry Flight Demonstration Number One (RFD-1) are described. The RFD-1 reentry system consisted of the SNAP-10A Simulated Test Reactor (SNAP-10A STR), the external fuel rod experiment, and the reentry vehicle. The latter included the telemetry package and the vehicle assembly (with recovery system and Scout fourth-stage separation components). The SNAP-10A STR was instrumented to monitor transient temperature response as well as the sequence of reactor disassembly during reentry heating. The telemetry package transmitted the data obtained with this instrumentation and provided electrical functions for the reentry vehicle. The reentry vehicle itself served two purposes: (1) aerodynamically stable support for the SNAP-10A STR, and (2) housing for the telemetry package and the recovery system. The reentry vehicle was designed to survive reentry heating and to follow a predetermined trajectory after being carried into outer space on a four-stage NASA Scout vehicle. The exterior fuel rods, which were ejected, contained flare material so that optical information on fuel-rod burnup could be obtained. The performance of the vehicle during the flight is discussed and compared with preflight predictions. (auth)

31022 (UCRL-6146(Pt.I)) A SUMMARY OF TORY II-A AEROTHERMODYNAMICS. PART I. P. M. Uthe (California. Univ., Livermore. Lawrence Radiation Lab.). Dec. 7, 1960. Contract W-7405-eng-48. 96p.

A summary of the aerothermodynamic calculations that were made during the evaluation of the Tory II-A reactor is presented. A presentation is made of the computational techniques developed, the material properties utilized, and the calculational results obtained. In addition, relations fundamental to the analysis are discussed. (auth)

31023 THE NATIONAL NUCLEAR ROCKET PROGRAM IN THE UNITED STATES. W. C. Beckwith (Aerojet-General Corp., Azusa, Calif.). Atompraxis, 10: 218-25 (May 1964).

The development, organization, and status of the nuclear rocket program are reviewed, with emphasis on the KIWI and NERVA projects. The capabilities of NERVA-class engines for lunar and planetary missions are discussed in relation to all-chemical rocket systems. (D.C.W.)

31024 NUCLEAR PROPULSION IN SPACE FLIGHT. E. Saenger (Technische Universität, Berlin). Atompraxis, 10: 226-34(May 1964). (In German)

Starting from the limits of chemical propulsion, the fundamental possibilities of nuclear propulsion in space flight in form of convective fission rockets, mixed fission rockets, electric fission rockets, photonic fission rockets, and true fission rockets are discussed. The prospective trends in astronautical propulsion are demonstrated. (auth)

31025 NUCLEAR ENERGY IN SPACE PROPULSION SYSTEMS. L. R. Shepherd (OECD High Temperature Reactor Project, Dorset, Eng.). Atompraxis, 10: 234-41 (May 1964).

After showing the limitations of the conventional chemical rocket, the problems and possibilities of the high-thrust nuclear vehicle as well as low-thrust electrical propulsion systems are discussed. (auth)

31026 THE DEVELOPMENT OF NUCLEAR ROCKET PROPULSION IN THE UNITED STATES. William C. House (Aerojet-General Corp., Azusa, Calif.). J. Brit. Interplanet. Soc., 19: 306-18(Mar.-Apr. 1964).

The development and status of nuclear engine activities are briefly reviewed, with emphasis on the KIWI and NERVA programs. The applicationof NERVA-class engines to lunar landing and planetary fly-by missions is considered. Solar system escape capability is indicated, and comparisons are made with a chemical counterpart vehicle. (D.C.W.)

31027 NUCLEAR POWER SOURCES FOR ELECTRICAL PROPULSION. L. R. Shepherd (United Kingdom Atomic Energy Authority, Winfrith, Dorset, Eng.). J. Brit. Interplanet. Soc., 19: 350-60(Mar.-Apr. 1964).

Possible alternative nuclear powerplants for electrically propelled spacecraft are considered, and the problems likely to arise in their development are assessed. A hypothetical vehicle with initial mass of 15 tons and a useful

power output of 750 kw is taken as a basis for discussion. (auth)

31028 TECHNIQUES FOR VACUUM IN-PILE IRRADIATION OF SNAP COMPONENTS. S. J. Basham, H. T. Gruber, and B. P. Fairand (Battelle Memorial Inst., Columbus, Ohio). p.417-26 of "Institute of Environmental Sciences, 1964 Proceedings." Mt. Prospect, Ill., Institute of Environmental Sciences, 1964.

The experimental program carried out at Battelle in support of SNAP 8 and 10A development is outlined. Provision of the desired nuclear environments, neutron and gamma measurements, the irradiation facilities, and the measurement and data acquisition system are described. The types of measurements made are indicated. (D.C.W.)

Research and Test Reactors

Refer also to abstract 29836.

31029 (AID-Report-P-64-4) SOVIET HEAVY-WATER RESEARCH REACTOR TVR. Summary of Data. (Library of Congress. Aerospace Information Div., Washington, D. C.). Jan. 21, 1964. 12p. (AD-430342)

A detailed description of the TVR reactor is presented. The presentation includes background information, design features, reactor parameters, and information on experimental facilities afforded by the reactor. Illustrations are included. (auth)

31030 (EUR-1636.e) SHIELDING EXPERIMENTS AND CALCULATIONS AT THE RESEARCH REACTOR GEESTHACHT, GERMANY. D. Buenemann, H. G. Fendler, R. Fiebig, F. Frisius, O. Hoffmann, H. Kotschi, H. Patzelt, G. Richter, and G. Thuro (Gesellschaft für Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht, Germany). 1964. 41p.

Measurements at two shielding facilities and their theoretical interpretation are treated. Collimated beam experiments were performed at ESTAKOS. By testing relatively small probes of shielding materials it is possible to derive some criteria for the shielding efficiency of different arrangements. The results can be related to plane geometry by means of a theorem of reciprocity. In the second facility ESTAGROP, mockup experiments of possible reactor shields were performed. In order to avoid side effects, large slabs of 2 × 2.5 m are placed directly in front of the core in the reactor pool up to a maximum thickness of about 2 m. The calculations of neutron fluxes are based on the current methods of removal and multigroup diffusion theory. For the calculation of the γ-dose, the buildup concept is used. In spite of the large slab size strong corrections have to be introduced at certain points in order to fit the calculations to the measured data. A simple explanation for these effects is given. Some difficulties result from the complicated core geometry. (auth)

31031 (IDO-24452) STUDY S-R-98—REACTIVITY ACCIDENT STUDY FOR ADVANCED TEST REACTOR. [R. N. Moore] (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). Sept. 1961. For Ebasco Services, Inc., New York. Contract [AT(10-1)-1075]. 66p.

Positive reactivity accidents were studied for the Title I ATR reference reactor; a gas-cooled reactor experiment, a NaK-cooled thermal package loop, and sodium-cooled fast package experiment, and a pressurized water loop for naval reactors were considered. Calculated reactivity insertion, reactor power time response, and reactor heat transfer are presented. Design changes for improvement of ATR accident response characteristics are discussed. (R.E.U.)

31032 (IDO-24453) STUDY S-R-100—THE ADVANCED TEST REACTOR NUCLEAR ANALYSIS USING A SINGLE-LOBE MODEL. H. M. Jones and W. K. Luckow (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). Mar. 1962. For Ebasco Services, Inc., New York. Contract [AT(10-1)-1075]. 89p.

The unusual multilobe configuration of the Advanced Test Reactor (ATR) is designed to make the experiments located within the lobes relatively independent. Much information on the behavior of these experiments is gained by isolating a single-lobe and studying its properties. Single-lobe calculations are reported, which offer the simplicity and computational economy of one dimension, and satisfactorily portray many characteristics of the actual multilobe reactor. No attempt was made to synthesize these single-lobe results into a composite two-dimensional description of the actual reactor. Instead, two-dimensional calculation techniques were used as the basic analytical tool in studying the multilobe reactor, which has several experiments exterior to the lobes and has reflector controls. The single-lobe studies were used to delineate the scope and to limit the required number of these long, complex two-dimensional calculations and for special studies such as the effect of experiment size. (auth)

31033 (IDO-24454) STUDY S-R-118—CLOSED-LOOP ANALOG STUDY FOR THE ADVANCED TEST REACTOR. [W. E. Carson] (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). Sept. 1962. For Ebasco Services, Inc., New York. Contract AT(10-1)-1075. 120p.

An analog computer was used to investigate performance of the Advanced Test Reactor (ATR) and associated control systems. The secondary valve control system was simulated to determine gain settings, stability, and performance. The temperature elements' time constants and locations had to be altered to obtain optimum results. The minimum stop on the secondary throttle valve imposes a reduction in reactor inlet temperature at low powers. To maintain 130°F reactor inlet temperature at a coldwell basin temperature of 85°F, reactor power must be above 5% of full power. When either the reactor power or the coldwell basin temperature is reduced below these values, the reactor inlet temperature drops below 130°F. The primary pressure control system was adequate for all plant transients. Limiting conditions on operation of the degassing system were found for the most severe transients. Analysis of plant transients for summer and winter atmospheric conditions indicated that satisfactory response can be obtained by adjusting controller gains and operating procedures. (auth)

31034 (IDO-24456) STUDY S-R-122—ADVANCED TEST REACTOR. AXIAL XENON STABILITY. S. W. Spetz (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). Nov. 1962. For Ebasco Services, Inc., New York. Contract AT(10-1)-1075. 50p.

Stability of the Advanced Test Reactor (ATR) with axial xenon oscillations was calculated using one-dimension analytic methods, digital-computer codes, and analog-computer simulations. It is concluded from these studies that the reference length is stable, but may exhibit an underdamped response to axial flux perturbations. The geometry problems that complicate all ATR nuclear calculations also influence the axial xenon problem. A one-dimension solution of this problem has inherent uncertainties that can be removed only in multidimension calculations. These uncertainties include such factors as proper handling of transverse bucklings and the relation of the one-dimensional threshold flux to a three-dimensional (real) flux. Xenon stability is a reactor characteristic that cannot be measured reasonably in the criti-

cal experiment. There is, therefore, no way to correlate stability calculations with physical reality. Since the potential difficulties associated with xenon instability or underdamped stability are so great, means of detection and control are appropriate. The amount of reactivity required for this purpose is very small. Predicted bare-equivalent threshold lengths are: (1) One-group analytic — 234 cm, (2) Two-group analytic — 155 cm, (3) Two-group analog — 157 cm. The actual bare-equivalent height of the reactor is 136 cm. (auth)

31035 (LFEN-16) DETERMINAÇÃO DA VIDA DOS NEUTRÕES PRONTOS NO REACTOR PORTUGUÊS DE INVESTIGAÇÃO (RPI). (Determination of the Prompt Neutron Lifetime of the Reactor Portugues de Investigacao (RPI)). Glenn S. Brunson and Jaime M. C. Oliveira (Portugal. Junta de Energia Nuclear. Laboratório de Física e Engenharia Nucleares, Sacavem). 1964. 38p.

Using an oscilloscope as a time analyzer and one conventional fission counter channel, the prompt-neutron lifetime of the "Reactor Português de Investigacão (RPI)" was measured by the "Rossi-alpha" method. Conditions were marginal due to a substantial photoneutron source resulting from (γ,n) reactions by fission product gammas. However, the result, (48 ± 4) microseconds, is in reasonable agreement with a calculated value of 52.8 microseconds. It is shown that the "Rossi-alpha" results can be used to estimate the intensity of the irremovable neutron source; in this case it was found to be $\sim 7 \times 10^3$ neutrons per second. (auth)

31036 (TID-20767) PROGRESS REPORT OF NORA PROJECT, SEPTEMBER 15, 1963–MARCH 15, 1964. (Norway. Institutt for Atomenergi, Kjeller). Contract AT(30-1)-2760. 42p. (NC-56)

The development and operation of NORA research reactor are summarized along with experimental and theoretical activities associated with the reactor. Information is given on lattice parameters for H_2O/D_2O moderated cores, critical water levels, buckling measurements, intracell thermal neutron density distribution, spectrum index, capture-to-fission ratios, initial conversion ratios, zero-power transfer function measurements using impulse channel method, neutron lifetime measurement by means of reactor noise analysis, analysis of the NORA experiments using BIGG and K-7 THERMOS calculations, theoretical studies of the thermal neutron density distribution inside the cell, and calculation of disadvantage factors for small cells. (N.W.R.)

31037 DETECTION OF RADIOELEMENTS IN THE WATER OF THE POOL REACTOR JEN-1. J. Montes, E. Artacho, and J. Sandoval (Junta de Energia Nuclear, Madrid). Anales Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 59: 261-72(Nov.-Dec. 1963). (In Spanish)

The detection and identification of radioelements in the water of a swimming pool reactor is observed. A continuous sampling of the water was proved to be an efficient method. A small flow of water is passed through 2-cm^3 anion and cation resins. The gamma emitters fixed in the resins are detected by a 256-channel analyzer. By this method different corrosion and fission products were detected in the water of the swimming pool reactor JEN-1. The total fission product activity was estimated to be less than 2.8×10^{-4} $\mu C/cm^3$. (auth)

31038 ATOMIC POWER: COOLING CIRCUIT USING LIQUID METALS. Combust., Chauffage Ind. Mod., No. 119, 1-11(Jan. 1963). (In French)

The cooling installation for the Rapsodie rapid neutron atomic reactor at Cadarache is described. This liquid metal circuit consists mainly of a primary loop carrying sodium and a secondary loop carrying sodium–potassium. The transmitted thermal power is 10 Mw and the maximum temperature 550°C. The equipment and the connecting pipework for the liquid metals are built in austenitic titanium-stabilized stainless steel. (auth)

31039 ANALYSIS OF THE NUCLEAR ACCIDENTS FOR THE ROSPO REACTOR CHARGED WITH PLATE FUEL ELEMENTS. C. Bona and A. Mathis (CNEN, Rome). Energia Nucl. (Milan), 11: 237-47(May 1964). (In Italian)

A detailed study is made of the accidents due to reactivity insertion possible in the ROSPO reactor, charged with plate fuel elements. ROSPO is a zero power reactor intended for neutron study of the cores of the PRO organic reactor. The accidents considered are the uncontrolled extraction of the central control rod for cores having a minimum and a maximum number of fuel elements and the rise of the moderator level at a 2 mm/s rate for cores having the maximum number of fuel elements. The development of these accidents without intervention of the safety systems is examined. The requirements are determined of a safety system able to avoid damage to the core. (auth)

31040 SILOE. Guy Deniélou (CEN, Grenoble, France). Energie Nucl., 6: No. 2, 59-64(Mar.-Apr. 1964). (In French)

The Nuclear Research Center at Grenoble has two open swimming pool reactors: Melusine and Siloe. Siloe was built to implement the work of Melusine, which was already being used to its full capacity. The Siloe design fulfills the need to better exploit the possibilities of open swimming pool reactors by better evaluating the limitations of specific power, and consequently of flux. The original characteristics of Siloe are compared with those of Melusine. (auth)

WASTE DISPOSAL AND PROCESSING

31041 (KFK-205) SCHRIFTTUMSUBERSICHT UBER ENDLAGERUNG RADIOAKTIVER ABFALLSTOFFE IN SALZFORMATIONEN. (Literature Search on Ultimate Disposal of Radioactive Wastes in Salt Formations). H. Ramdohr (Kernforschungszentrum, Karlsruhe, Germany). Mar. 1964. 43p.

A bibliographic study was made of the disposal of radioactive wastes in underground salt formations. The physical properties of salt and rock salt were given. The type and occurrence of rock salt is considered. The possibilities of deposition in rock salt by preparation of caverns or installation of a mine are examined. The practical research on the deposition of wastes in salt is reviewed, and the cost of such depositions was evaluated. Conclusions on the feasibility of waste disposal in salt formations for Germany were drawn from the data presented. 82 references. (J.S.R.)

31042 ENCASING RADIOACTIVE SLUDGE IN BITUMEN. J. Rodier, G. Lefillatre, and J. Scheidhauer. Energie Nucl., 6: No. 2, 81-8(Mar.-Apr. 1964). (In French)

The aim of the research is to transform the sludges which come from the treatment of radioactive effluents, by coprecipitation, into a solid, homogeneous product that is inert in the storage environment. The emulsifier and the chosen bitumen are added to the sludge and the water is eliminated by heating. Tests were carried out on the products obtained, in order to evaluate the diffusion of the radioelements in fresh and sea water and their resistance to microorganisms. (auth)

31043 SORPTION PHENOMENA OF RADIONUCLIDES TO CLAY PARTICLES IN RIVER WATER. Karen Garder (Inst. for Atomic Energy, Kjeller, Norway) and Olav Skulberg. Intern. J. Air Water Pollution, 8: 229-41(Mar.-Apr. 1964).

The sorption of radionuclides to river sediments was investigated. Both laboratory experiments and experiments in a model recipient were performed. In the laboratory experiments, post-glacial marine clay from the River Nitelva area, Norway, was investigated. In the model recipient the investigation was performed on bottom sediments of the same type as in Nitelva. The sorption of cesium, cerium, ruthenium, zirconium-niobium, yttrium, calcium, and strontium to sediments were measured. The results showed that appreciable amounts of cesium and cerium were sorbed to the sediments. The sorption of ruthenium, zirconium-niobium and yttrium was intermediate, and the sorption of strontium was insignificant. The results also indicate that in Nitelva the removal of radionuclides from solution was mainly due to sorption of suspended clay minerals. This work is part of an extensive investigation of problems related to radioactive pollution of fresh-water environments. (auth)

GENERAL AND MISCELLANEOUS

31044 (AD-428216) COMPARISON OF RAINIER RESULTS WITH RAND THEORY FOR CRATERING BY A SURFACE BLAST. Technical Note No. 62-15. F. B. Porzel (Institute for Defense Analyses, Washington, D. C.). Apr. 1962. 11p.

An appraisal of the results of RAND Research Memorandum RM 2600 is made by comparison with test results from RAINIER, a deep underground explosion. The standard $W^{\frac{1}{3}}$ scaling is used to scale the RM 2600 theoretical results down to the RAINIER yield, and the crushing radii are then compared. Pressure-distance curves are also compared. It is concluded that the RM 2600 methods are not reliable even for the simple case of a spherical explosion in soil. (D.L.C.)

31045 (AD-428227) THE GNOME EXPLOSION AND ITS BEARING ON NUCLEAR TEST DETECTION. Technical Note No. 62-11. Joseph W. Berg, Jr. (Institute for Defense Analyses, Washington, D. C.). Mar. 1962. 7p.

The early analysis of the seismic data from the GNOME salt underground explosion (Dec. 10, 1962) are assessed with respect to nuclear test detection. The source, propagation paths, recording sites, and effects on Geneva criteria are discussed. Some suggested shot programs for Vela Uniform are given. (D.L.C.)

31046 (AFCRL-63-902) THE PROGRESS AND PRESENT STATUS OF SCIENCE IN INDIA. Hari K. Sen (Air Force Cambridge Research Labs. Laurence G. Hanscom Field, Bedford, Mass.). Nov. 1963. 111p. (AD-430818)

This report gives an account of the progress and present status of science in India. Its scope is in the main limited to developments of Indian science in plasma physics and geo-astrophysics. It does not attempt to describe all universities and research institutions in India. It does, however, give a fairly broad cross-section of Indian scientific research in the aforementioned fields. (auth)

31047 (CONF-569-1) THE DEVELOPMENT OF CONDUCTIVE ADHESIVES FLEXIBLE AT LOW TEMPERATURES. L. W. Hartzel and S. S. Sakornbut (Mound Lab., Miamisburg, Ohio). Mar. 9, 1964. Contract [AT(33-1)-Gen-53]. 18p.

From the 7th National SAMPE Symposium, Los Angeles, May 1964.

Conductive adhesives flexible at −65°F were developed with specific resistivities comparable with rigid amine-cured epoxy-silver systems. Metal powders were investigated as fillers for polyurethane matrix materials, and the effect of particle size of the filler on the resistivity of the adhesive was determined. The introduction of carbon black with silver powder into polyurethane formulations significantly decreased resistivity. Polysulfide and silicone matrix adhesives containing silver-carbon black fillers have been prepared, which also have low specific resistivities. Physical and electrical properties of these materials at −65°F and the effect of moderate temperatures (160°F) resistivity of these materials are discussed. (auth)

31048 (COO-689-42) CORRELATION AND CHRONOLOGY OF ORE DEPOSITS AND VOLCANIC ROCKS. Annual Progress Report. Paul E. Damon (Arizona. Univ., Tucson. Geochronology Labs.). June 1, 1964. Contract AT(11-1)-689. 117p.

Techniques are described for K−Ar and Rb−Sr dating methods, and their applications in the dating of various minerals. The uses of these dating methods for geochronological analyses are described. Geological studies are reported on the Roskruge Mtns., the Silver Bell and Esperanza mining areas, the Tucson Mtns., the Napak I Locality in Karamoja, Uganda, and the Providencia mining area in Mexico. The performance of the He method for dating magnetite is studied. The determination of Ag, Bi, U, and Hg in galena is reported. The geochemistry of Turkey Track andesite porphyry is analyzed. The geological melting of silicates is investigated. (T.F.H.)

31049 (NP-14032) ACTIVITIES OF THE COMMUNITY. Sixth General Report, March 1962−February 1963. (European Atomic Energy Community). Mar. 1963. 298p.

The activities of EURATOM are reported. The second five-year research and training program (1963-1967) is discussed. The chapters are entitled Research and Training, Dissemination of Information, Industry and Economy, Health and Safety, Safeguards and Controls, External Relations, Administration and Personnel, Finance, and Community Institutions and Inter-Executive Cooperation. (D.L.C.)

31050 (SC-DC-64-764) CIRCULATION PROCESSES AND MIXING MECHANISMS IN THE UPPER ATMOSPHERE ABOVE 30 KM. Quarterly Progress Report No. 2, December 15, 1963−March 15, 1964. (Geophysics Corp. of America, Bedford, Mass.). For Sandia Corp., Albuquerque, N. Mex. Contract [AT(29-1)-789]. 21p.

From terminal fall velocities in the ARDC model atmosphere (1959), the total time of particle descent from 70 to 30 km is calculated for 2, 6, 10, and 20 micron diameter particles. With an assumption of a Gaussian distribution of particles about the cloud center of gravity and a relative dispersion, σ^2, of the form $\sigma^2 = 2K_e t$, the intersection of different particle concentration surfaces with the 100,000 ft altitude level is computed. In this zero-order model, the result of all dispersive effects acting upon the particle cloud are concentrated in the effective "eddy diffusion" parameter K_e. (auth)

31051 (SC-R-64-128) THE DEPENDENCE OF THE SMALL-SIGNAL PARAMETERS OF FERROELECTRIC CERAMIC RESONATORS UPON STATE OF POLARIZATION. C. E. Land, G. W. Smith, and C. R. Westgate (Sandia Corp., Albuquerque, N. Mex.). Jan. 1964. Contract [AT(29-1)-789]. 53p. (CONF-547-1)

From the IEEE Ultrasonic Symposium, Washington, D. C., Dec. 1963.

Some general results of a study of the polarization-dependence of the small-signal parameters of hot-pressed, lead zirconate titanate ceramic bar and disk resonators are discussed. Measurements were made of both the free admittance loci in the vicinity of principal resonances and the high frequency clamped impedance as the polarization was varied in increments from negative to positive saturation remanence. The results of these measurements are presented in terms of the variation of equivalent circuit parameters as functions of the polarization. From the established relations between resonator equivalent circuit parameters and material properties, it is shown that the significant polarization-dependent material properties are piezoelectric coupling, clamped permittivity, and elastic compliance. Piezoelectric coupling and elastic compliance vary directly with polarization; clamped permittivity varies inversely with polarization. For the rhombohedral lead zirconate titanate compositions measured, hysteresis in the relations between material properties and polarization depends strongly upon the magnitude of the poling field. For poling fields up to twice the coercive field, piezoelectric

coupling and clamped permittivity are essentially anhysteretic functions of polarization. Hysteresis effects which would normally be attributed to elastic losses are shown to be more accurately associated with piezoelectric coupling, since the losses are dependent upon the magnitude of the coupling. Evidence is presented to show that these effects may be explained by introducing a phase angle in the effective piezoelectric coupling coefficient. The possibility of using ferroelectric ceramic resonators as multistate memory devices with continuous, small-signal, nondestructive readout is discussed. (auth)

31052 (TEI-848) GEOLOGIC MAP ON THE FRENCHMAN FLAT QUADRANGLE, NYE, LINCOLN, AND CLARK COUNTIES, NEVADA. Forrest G. Poole (Geological Survey, Washington, D. C.). June 1964. 21p.

31053 (TID-20764) THE CIRCULATION OF THE STRATOSPHERE. Progress Report. Reginald E. Newell (Massachusetts Inst. of Tech., Cambridge). June 1, 1964. Contract AT(30-1)-2241. 13p.

Basic calculations on the general circulation of the stratosphere have been carried out. It is found that, just as in the troposphere, large-scale quasi-horizontal eddies are important in the budgets of angular momentum, energy, and mass. (auth)

31054 (UCRL-7877) UNIFORMITY OF OUTPUT FROM A LOW-AMPLITUDE PLANE-WAVE NITROGUANIDINE EXPLOSIVE SYSTEM. J. R. Hearst and L. B. Geesaman (California. Univ., Livermore. Lawrence Radiation Lab.). May 12, 1964. Contract W-7405-eng-48. 18p.

Four-inch-diameter, 0.4 g/cc nitroguanidine high explosive lenses were tested for simultaneity and pressure uniformity. Shock breakout is simultaneous over a 5-cm diameter within ±0.04 μsec, and over a 3-in. diameter within ±0.06 μsec. Pressures are within ±7% of the central value over a 6.3-cm diameter after 1 mm of plate travel. Detonation pressure was measured at 28 kbars, and a curve of pressure vs particle velocity was prepared. (auth)

31055 (UCRL-10558) FILM DEPOSITS AND WHISKER GROWTH IN THE ELECTRON MICROSCOPE. P. W. Osborne and A. E. Bayce (California. Univ., Berkeley. Lawrence Radiation Lab.). Aug. 1963. Contract W-7405-eng-48. 11p.

Whisker growth has been observed on a soda-lime-silica glass during observation in an electron microscope under a high intensity beam. A similar growth was also noted on an electron microscope copper support grid which had been dipped in diffusion pump oil. Both the whiskers on the glass and the grid had identical electron diffraction patterns. It may be concluded that the whiskers are a decomposition product of the diffusion pump oil. (auth)

31056 (SC-4452C(M)) SANDIA CORPORATION STANDARD ENVIRONMENTAL TEST METHODS. (Sandia Corp., Albuquerque, N. Mex. and Sandia Corp. Livermore Lab., Livermore, Calif.). July 1964. Contract [AT(29-1)-789]. 100p.

This publication supersedes SC-4452B(M) dated February 1963.

Minimum requirements in the form of process standards covering the instrumentation, equipment, and methods to be used in conducting environmental tests on Sandia Corporation components are set forth. General guidance is included to help design, development, and test personnel achieve uniformity of testing. A check list for preparation of the environmental testing portion of product specifications is also included to promote uniformity of specifications. (auth)

31057 (UCRL-11451) THE SHAPE OF DEFORMATION TWINS. Roger E. Cooper (California. Univ., Berkeley. Lawrence Radiation Lab.). May 1964. Contract W-7405-eng-48. 34p.

The factors which influence the shape of deformation twins have been considered. The case of wedge shaped elastic twins has been examined in detail from two points of view—force and energy—and under two types of stress variation. The method involving the calculation of forces acting on individual twinning dislocations can give more information about precise twin shapes and even in the simple form as developed it shows the way in which the dislocation density varies along the twin length. The results obtained by this method, however, depend on an accurate knowledge of the magnitude of the shear stress along the whole length of the twin. It appears that the shape assumed by a twin depends primarily upon the magnitude of shear stress necessary to form it and the way in which this shear stress varies along the length of the twin. The surface energy determines only the shape near the tip of the twin. This behavior is summarized in the form of sketches of twin profiles. (auth)

31058 (ANL-Trans-34) POLYPLUMBIDES, POLYSTANNIDES AND THEIR TRANSITION IN METAL PHASES. (2. COMMUNICATION ON METALS AND ALLOYS). E. Zintl and A. Harder. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from Z. Physik. Chem., 154A: 47-91(1931). 42p.

By extraction of suitable Na–Pb and Na–Sn alloys with liquid NH_3, pure solutions of the saltlike compounds sodium enneaplumbide $Na_4Pb_9 \cdot xNH_3$ and sodium enneastannide $Na_4Sn_9 \cdot xNH_3$ in liquid NH_3 can be prepared. Such solutions are ammonosols and contain aggregates of polyanions $[Pb_9]^{4-}$ and $[Sn_9]^{4-}$. Na_4Pb_9 and Na_4Sn_9 can be obtained from the NH_3 solutions as amorphous nonmetallic ammines, and further removal of NH_3 transforms these compounds into alloy phases. The structure of the α and β phases of the Na–Pb system is studied and discussed. The decomposition of $[Na(NH_3)_n]_4[Pb_9]$ into the β phase is discussed. (D.L.C.)

31059 MASSIVE RADIATION TECHNIQUES. Sidney Jefferson, ed. New York, John Wiley & Sons, Inc., 1964. 329p. $11.50.

Commercial applications of γ radiation and high-energy electrons are reviewed. It is pointed out that radiation may be used to bring about desirable effects in the materials treated. Interactions of radiation with matter, radiation sources, and radiation dosimetry are discussed. Topics discussed in detail include applications of radiation in agriculture for experimental soil sterilization, the disinfestation of stored food products, and in plant breeding programs; for the sterilization of medical equipment and pharmaceutical products; in food processing; and in insect control by exposure of developing insects, the release of radiation-sterilized males to the insect population, and tracer studies on the biochemical effects of various insecticides. Applications of radiation in the chemical industry discussed include the radioinduced polymerization of a variety of materials, radioinduced halogenation, radioinduced oxidation, radioinduced cracking of hydrocarbons, radioinduced alkylation, radioinduced addition reactions; radiation effects on catalysts; and the direct utilization of fission product energy by industry. It is pointed out that investigations on the possible utilization of radiation in the chemical industry have been concentrated in a relatively small number of fields and that many basic reactions that might be initiated by radiation have not been studied to any large extent. (1239 references.) (C.H.)

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æ	becomes	ae
ö		oe
ø		oe
ü		ue (except in transliterated Chinese names)

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SUBJECT INDEX

Main entries in this index are generally specific materials, things, and processes. These are followed by modifiers that describe the properties of, and processes applied to, the main entries.

The number preceding the colon is the *NSA* volume number, and the number following is the abstract number. The designation (R) following the abstract number indicates that the abstract is of a progress report; (P) indicates a patent; and (T) indicates a translation. Abstracts for reports other than progress reports carry no letter designation. References to report numbers, where appropriate, are included after the abstract number of the citation. Published literature (journal article or book) is indentifiable by the absence of a report number.

General Indexing Style

The user should bear in mind that the ideas presented in the original literature, rather than key words, have been indexed. The indexers have tried to select what seemed the most probable and logical place to look for typical information. Since it is not possible to anticipate where a user would look for information, numerous cross references are included to assist him in his search.

Experience in using an index of this type will be the best guide in obtaining the desired information, and a consideration of synonymous or closely related terms will prove valuable.

Information must be so indexed as to be of the greatest use to the greatest number of users. This requires that a topic be indexed to headings that most specifically describe it and not ordinarily to the headings that describe its ultimate use, nor to the general class headings that include the specific headings. For example, information on the treatment of thyroid disease with I-131 would be indexed under Thyroid Diseases and under Iodine Isotopes I-131, but not necessarily under Radiotherapy. A study of the effects of x radiation on hair would be indexed under both X Radiation and Hair. However, the information would not be indexed under the experimental animal, e.g., Rats, unless the report discusses the effects on rat hair as compared with the effect on the hair of other animals.

The broad, general class headings are used only for general information or for comprehensive reports or articles.

Subject Heading Styles

Generally, the direct form of subject entry is used rather than inverted headings or, in some cases, subheadings; e.g., Amino Acids rather than Acids, amino; Helium Isotopes He-4 rather than Helium—isotopes He-4 or Helium—He-4 isotopes. Note, however, that in some cases modifying terms are used parenthetically in preference to a more direct type of entry which would result in the scattering of information. Organic compounds, however, are usually entered in the index in the inverted form so that substituted compounds can be listed near the parent compound; e.g., Benzene, Bromo- rather than Bromobenzene. In general, the style of nomenclature used is that of *Chemical Abstracts*, except that some items listed in that publication as subheadings are elevated to form part of the main heading; e.g., Butyric Acid, Methyl Ester rather than Butyric Acid—methyl ester.

Alphabetization

Main headings are arranged according to the widely accepted word-by-word alphabetic system. A parenthetic qualifier following a main heading is disregarded in alphabetizing unless there are two or more headings identical except for the parenthetic qualifier, in which case the qualifier determines the order. Headings involving Greek letters are arranged as if the names of the letters were spelled out, e.g., Mesons (π), Mesons (ξ).

Nomenclature of Inorganic Compounds

Inorganic compounds are indexed in the direct form, listing cations in the order of increasing valence in the case of polycationic salts of varying valence and in alphabetic order for polycationic salts in which all cations have the same valence; e.g., Sodium Aluminum Silicates and Potassium Sodium Sulfates.

Multicomponent Systems

Multicomponent alloys, except well-known trade names are indexed under each element in the alloy.

Example: Aluminum–Chromium Alloys are indexed

ALUMINUM ALLOYS
Al–Cr ...
CHROMIUM ALLOYS
Al–Cr ...

Well-known alloys such as Hastelloy are indexed directly with cross references under the element components. Multicomponent systems of elements are indexed similarly.

Example: Silicon–Tungsten Systems are indexed

SILICON SYSTEMS
Si–W ...
TUNGSTEN SYSTEMS
Si–W ...

Multicomponent systems of compounds are similarly indexed under the compound.

Physical States of Materials

In this subject index specification of the physical state of the material, if other than normal, is included in the modifying phrase.

Modifying Phrases (Subheadings)

Descriptive phrases (modifiers), rather than ordinary subheadings, are used under the main headings to give a better indication of the material covered in an abstract than would be possible with only a word or two whenever it appears that such information would be useful. Such phrases are written so that the idea considered most important is presented first, should a not-too-awkward expression result. However, when using this index, the reader is advised to scan all modifiers under a main heading to determine whether any abstracts in addition to the most obvious should be consulted for the desired information. Many of the modifiers are designed to be read in inverted order or to be read with the main heading inserted at the position of the comma in order to obtain a meaningful phrase; e.g., Uranium—allotropic transformation temperatures of, effect of cooling rate on is read "effect of cooling rate on allotropic transformation temperatures of uranium." In many cases, the prepositions have been omitted from such phrases provided no ambiguity results from the omission.

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1	18-29166	See ORNL-P-70
COO–		
119-229	18-29164	Dep.(mc); $14.50(fs), $6.59(mf) OTS
605-6	18-30717	Dep.(mc); $1.10(fs), $0.80(mf) OTS
689-42	18-31048	Dep.(mc); $9.60(fs), $3.71(mf) OTS
1028-2	18-29810	Dep.(mc); $6.60(fs), $2.30(mf) OTS
1328-7	18-30616	Dep.(mc); $8.60(fs), $3.17(mf) OTS
CU–	(Misc.)	
3-64-SC-90789 Phys.	18-30298	See AD-439695
CVNA–	(Misc.)	
206	18-30982	Dep.(mc); $3.60(fs), $1.25(mf) OTS
D–	(Misc.)	
1-82-0340	18-30305	
2-90469	18-29877	
DC–	(Misc.)	
60-8-58	18-31017	Dep.(mc); $1.10(fs), $0.80(mf) OTS
DP–		
443	18-30149	Dep.(mc); $1.60(fs), $0.80(mf) OTS
654	18-29692	Dep.(mc); $2.60(fs), $0.86(mf) OTS
888	18-30231	Dep.; $0.50(OTS)
DPC-CPh–	(British)	
62/95	18-29609	For translation see AERE-Trans-999
DPR-INF–	(British)	
274	18-30983	Dep.(mc)
DRI–	(Misc.)	
2137	18-30479	$5.60(OTS)
DUBNA REPORTS	(Russian)	
See JINR (Russian)		
EANDC-US–	(European-American Nuclear Data Committee)	
46U	18-29976	
EFINS–	(Misc.)	
64-11	18-30597	Phys. Rev., 135: B567-9(1964)
EM–	(Misc.)	
193	18-30872	See AFCRL-63-376
ER–	(Misc.)	
6929	18-30238	See NP-14102
EUR–	(European Atomic Energy Community)	
8.f	18-30150	Dep.(mc)
86.d	18-30110	Dep.(mc)
117.e	18-30151	Dep.(mc)
528.e	18-29919	Dep.(mc)
1454.e	18-30232	See EURAEC-854
1587.e	18-30095	See EURAEC-987
1601.e	18-29556	Dep.(mc)
1617.i	18-30296	Dep.(mc)
1621.e	18-31018	Dep.(mc)
1630.e	18-30944	Dep.(mc)
1632.f	18-30092	Dep.(mc)
1636.e	18-31030	Dep.(mc)
1811.n	18-30984	Dep.(mc)
1822.f	18-30306	Dep.(mc)
1824.i	18-30093	Dep.(mc)
1839.e	18-30094	Dep.(mc)
EURAEC–		
792	18-30155	Dep.(mc); $2.60(fs), $1.07(mf) OTS
854	18-30232	Dep.(mc); $2.60(fs), $0.83(mf) OTS
914	18-30156	Dep.(mc); $7.60(fs), $2.33(mf) OTS
922	18-29847	Dep.(mc); $1.60(fs), $0.83(mf) OTS
933	18-30157	Dep.(mc); $8.60(fs), $2.93(mf) OTS
955	18-30134	Dep.(mc); $2.60(fs), $1.04(mf) OTS
987	18-30095	Dep.(mc); $7.60(fs), $2.39(mf) OTS
1014	18-29568	Dep.(mc); $6.60(fs), $2.12(mf) OTS
1016	18-30977	Dep.(mc); $1.60(fs), $0.80(mf) OTS
1017	18-30180	Dep.(mc); $1.60(fs), $0.80(mf) OTS
1026	18-29848	Dep.(mc); $1.60(fs), $0.80(mf) OTS
1033	18-30108	See BMI-X-10083
1036	18-30158	Dep.(mc); $2.60(fs), $0.92(mf) OTS
1040	18-29610	Dep.(mc); $1.60(fs), $0.80(mf) OTS
1047	18-30135	Dep.(mc); $9.60(fs), $3.59(mf) OTS
1061	18-30136	Dep.(mc); $3.60(fs), $1.19(mf) OTS
1067	18-30159	Dep.(mc); $2.60(fs), $1.04(mf) OTS
1072	18-29835	See BAW-3238-3
1083	18-29837	See GEAP-4492
FD–	(Non-AEC)	
1	18-30706	See AD-428207
FR–	(Misc.)	
63-17-179	18-29913	See AD-430654
GA–	(Misc.)	
4786	18-30985	Dep.(mc); $1.60(fs), $0.80(mf) OTS
5123	18-30233	Dep.(mc); $3.60(fs), $1.19(mf) OTS
5259	18-30234	Dep.(mc); $1.10(fs), $0.80(mf) OTS
GAMD–	(Misc.)	
4526	18-30986	Dep.(mc); $4.60(fs), $1.61(mf) OTS
GEAP–	(Misc.)	
4450	18-30129	Dep.(mc); $6.60(fs), $2.24(mf) OTS
4492	18-29837	Dep.(mc); $7.60(fs), $2.33(mf) OTS
4495	18-30130	Dep.(mc); $7.60(fs), $2.48(mf) OTS
GEMP–	(Misc.)	
35A	18-30111	Dep.; $1.50(OTS)
GLR–		
21	18-29844	See SAN-409-1
HW–		
46093	18-29800	Dep.(mc); $3.60(fs), $1.34(mf) OTS
67241	18-29693	Dep.(mc); $3.60(fs), $1.16(mf) OTS
76304	18-30112	Dep.; $2.50(OTS)
79616	18-31016	Dep.; $1.00(OTS)
79843	18-30152	Dep.; $7.60(fs), $2.51(mf) OTS
80535	18-29838	Dep.; $0.50(OTS)
80957	18-30945	Dep.(mc); $1.10(fs), $0.80(mf) OTS
HW-SA–		
3079	18-29210	Health Phys., 10: 391-8(1964)
3160	18-29906	Radiation Res., 22: 489-506(1964)
3356	18-29811	Dep.(mc); $2.60(fs), $1.01(mf) OTS
3434	18-29878	Dep.(mc); $2.60(fs), $0.89(mf) OTS
3546	18-29812	Dep.(mc); $4.60(fs), $1.46(mf) OTS
IA–	(Non-AEC)	
835	18-30775	Nucl. Phys., 54: 568-76(1964)
842	18-30765	Nucl. Instr. Methods, 26: 209-12(1964)
913	18-29694	Dep.(mc)
IBM–	(Non-AEC)	
63-521-21	18-29920	$3.50(OTS)
IDO–		
16825	18-31019	Dep.; $3.00(OTS)
24452	18-31031	Dep.(mc); $6.60(fs), $2.18(mf) OTS
24453	18-31032	Dep.(mc); $8.10(fs), $2.87(mf) OTS
24454	18-31033	Dep.(mc); $9.60(fs), $3.80(mf) OTS
24456	18-31034	Dep.(mc); $4.60(fs), $1.70(mf) OTS
28526	18-30987	Dep.(mc); $10.50(fs), $4.34(mf) OTS
INSJ–	(Japanese)	
69	18-30438	Dep.(mc) p.326-45 of "International Conference on Cosmic Rays. Vol. 5." Bombay, Tata Inst. of Fundamental Research, 1964.
IS–		
651	18-29683	J. Phys. Chem., 67: 2413-16(1963)
656	18-30678	Proc. Iowa Acad. Sci., 70: 387-91(1963)
802	18-29626	Inorg. Chem., 3: 993-5(1964)

Report No.	Abstract No.	Availability
870	18-30307	Dep.; $0.75(OTS)
JEN–	**(Spanish)**	
129-DF/I-40	18-30884	Dep.(mc)
JINR–	**(Russian)**	
E-1659	18-30509	Dep.(mc)
P-1622	18-30510	Dep.(mc)
P-1633	18-29921	Dep.(mc)
P-1638	18-30617	Dep.(mc)
P-1641	18-30718	Dep.(mc)
P-1642	18-30719	Dep.(mc)
P-1651	18-30720	Dep.(mc)
P-1654	18-30511	Dep.(mc)
P-1658	18-30618	Dep.(mc)
P-1662	18-30512	Dep.(mc)
P-1663	18-30721	Dep.(mc)
P-1665	18-30722	Dep.(mc)
P-1676	18-29977	Dep.(mc)
JPRS–	**(Non-AEC)**	
25104	18-29867	$0.50(OTS)
25168	18-30898	$4.00(OTS)
25344	18-30319	$0.50(OTS)
JüL–	**(German)**	
156-RE	18-30946	Dep.(mc)
157-PP	18-30885	Dep.(mc)
158-ST	18-30689	Dep.(mc)
KAPL-P–		
1861	18-31003	Elec. Eng., 6p. (1957)
KFK–	**(German)**	
188	18-29978	Dep.(mc)
201	18-29922	Dep.(mc)
204	18-30171	Dep.(mc)
205	18-31041	Dep.(mc)
KR–	**(Norwegian)**	
83	18-29557	Dep.(mc); $3.60(fs), $1.22(mf) OTS
KY–		
458	18-29879	Dep.; $0.50(OTS)
LA–		
2811(Add.II)	18-30723	Dep.; $0.75(OTS)
3064	18-29822	Dep.; $2.00(OTS)
3088	18-29558	Dep.; $0.50(OTS)
LA-tr–		
64-8	18-30320	Dep.(mc); $1.10(fs), $0.80(mf) JCL or OTS
LADC–		
5901	18-30096	Dep.(mc); $1.60(fs), $0.80(mf) OTS
5937	18-29198	Dep.(mc); $1.60(fs), $0.80(mf) OTS
5945	18-30400	Dep.(mc); $2.60(fs), $0.89(mf) OTS
5950	18-30401	Dep.(mc); $1.10(fs), $0.80(mf) OTS
6049	18-30759	J. Math. Phys. (N. Y.), 5: 998-9(1964)
6087	18-29602	Dep.(mc); $1.10(fs), $0.80(mf) OTS Inorg. Chem., 3: 1137-40(1964)
6107	18-30621	Am. J. Phys., 32: 542-5(1964)
6173	18-30256	Rev. Sci. Instr., 35: 842-6(1964)
6204	18-30144	Science, 144: 1570-2(1964)
6219	18-29880	Dep.(mc); $1.60(fs), $0.80(mf) OTS
6258	18-30592	Phys. Rev., 135: B510-15(1964)
6395	18-30503	Nucl. News, 7: No. 7, 3-6(1964)
6399	18-30798	Phys. Letters, 10: 204-7(1964)
6415	18-29923	Dep.(mc); $2.60(fs), $1.01(mf) OTS
LAMS–		
3085	18-30886	Dep.; $2.00(OTS)
3090	18-29881	Dep.; $0.50(OTS)
3096	18-30975	Dep.; $0.50(OTS)
LFEN–	**(Portuguese)**	
16	18-31035	Dep.(mc)
LNF–	**(Italian)**	
64/11	18-29979	Dep.(mc)
64/14	18-30574	Phys. Letters, 10: 245-7(1964)
LRP–	**(Swiss)**	
14-64	18-29924	Dep.(mc)
MATT–		
223	18-30632	J. Math. Phys. (N. Y.), 5: 930-43(1964)
237	18-30903	2p. of IEEE (Inst. Elec. Electron. Engrs.), Trans. Microwave Theory Tech., MTT-12; No. 2, (1964)
275	18-30918	Phys. Rev. Letters, 13: 47-50(1964)
MDL–	**(Non-AEC)**	
Q3	18-29925	$5.60(OTS)
MF–	**(Misc.)**	
39	18-30891	See NYO-9371
MITNE–	**(Misc.)**	
42	18-29555	See AFCRL-63-575
MLM–		
1188	18-30114	Dep.; $0.50(OTS)
MND–	**(Misc.)**	
3127	18-30480	$6.60(OTS)
MSAR–	**(Misc.)**	
64-65	18-30131	Dep.(mc); $1.60(fs), $0.80(mf) OTS
N–	**(Misc.)**	
64-14946	18-30688	
64-15185	18-30379	See NASA-CR-55384(p.313-68)
64-20726	18-30235	$6.60(OTS)
NAA-SR–		
130(Del.)	18-30345	Dep.(mc); $12.00(fs), $5.30(mf) OTS
6920	18-30988	Dep.; $1.00(OTS)
7264	18-30947	Dep.; $0.50(OTS)
8579	18-30989	Dep.; $1.50(OTS)
8906	18-29839	Dep.; $1.50(OTS)
9717	18-30990	Dep.; $0.50(OTS)
NAA-SR-Memo–		
8215(Pt.8)	18-31020	Dep.(mc); $3.60(fs), $1.13(mf) OTS
NAEC-AML–	**(Non-AEC)**	
1854	18-29980	$1.60(OTS)
NASA-CR–	**(Non-AEC)**	
62	18-30236	$1.75(OTS)
68	18-30402	$2.00(OTS)
54048	18-30172	
54081	18-30132	
55384	18-30378	$21.00(fs), $1[illegible].03(mf) OTS
55384(p.313-68)	18-30379	
NASA-TN–	**(Misc.)**	
D-2345	18-30308	$0.50(OTS)
D-2357	18-30481	$1.75(OTS)
NASA-TT–	**(Non-AEC)**	
F-90	18-29814	$3.00(OTS)
F-127	18-30439	$5.00(OTS)
NAVWEPS–	**(Non-AEC)**	
8177	18-29926	$1.60(OTS)
NBL–		
210	18-29559	Dep.; $1.25(OTS)
NC–	**(Norwegian)**	
56	18-31036	See TID-20767
NDL-TM–	**(Non-AEC)**	
12	18-29981	
NIJS-R–	**(Yugoslavian)**	
420	18-30724	Dep.(mc)

Report No.	Abstract No.	Availability
NLCO–		
904	18-29565	Dep.(mc); $1.60(fs), $0.80(mf) OTS
NLCO-tr–		
1	18-30181	Dep.(mc); $5.60(fs), $1.88(mf) JCL
NORA–	**(Norwegian)**	
16	18-29557	See KR-83
NP–	**(AEC File No. for Non-AEC Reports)**	
13972	18-29982	Dep.(mc)
13976	18-30725	Dep.(mc)
13979	18-29928	
13982	18-30346	Dep.(mc)
13983	18-30347	Dep.(mc)
13987	18-30348	Dep.(mc)
13993	18-29929	
14021	18-29603	Free(NBS, Washington, D. C.)
14024	18-30726	
14032	18-31049	Dep.(mc)
14044	18-29825	
14047	18-30513	Dep.(mc)
14048	18-30514	Dep.(mc)
14051	18-30380	Dep.(mc)
14053	18-30727	Dep.(mc)
14055	18-30728	Dep.(mc)
14056	18-30729	Dep.(mc)
14066	18-30403	
14067	18-30888	Phys. Rev., 135: A627-31(1964)
14069	18-30237	
14079	18-30948	Dep.(mc)
14082	18-30889	
14087	18-30309	
14095	18-30890	
14096	18-30310	
14096(p.17-22)	18-29566	J. Geophys. Res., 69: 2881-5(1964)
14102	18-30238	
NP-tr–	**(AEC File No. for Non-AEC Translations)**	
1150	18-30121	Dep.(mc); $4.60(fs), $1.61(mf) JCL
NRL–	**(Misc.)**	
6094	18-29604	$1.25(OTS)
NYO–		
1807-12	18-30516	Dep.(mc); $1.60(fs), $0.80(mf) OTS
1807-13	18-30731	Dep.(mc); $1.10(fs), $0.80(mf) OTS
2404-3	18-29840	Dep.(mc); $1.10(fs), $0.80(mf) OTS
2545-1	18-30732	Dep.(mc); $1.10(fs), $0.80(mf) OTS
2930-4	18-29841	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2974-1	18-29842	Dep.(mc); $11.00(fs), $4.43(mf) OTS
9077	18-30949	Dep.(mc); $23.50(fs), $15.17(mf) OTS
9371	18-30891	Dep.(mc); $8.10(fs), $2.90(mf) OTS
9891	18-30733	Dep.(mc); $6.60(fs), $2.24(mf) OTS
10498	18-30297	Dep.(mc); $4.60(fs), $1.52(mf) OTS
ORA–	**(Misc.)**	
05222-2-T	18-29249	See TID-20815
ORNL–		
3619	18-30991	Dep.; $5.00(OTS)
ORNL-P–		
3	18-30892	Dep.(mc); $1.60(fs), $0.80(mf) OTS
70	18-29166	Dep.(mc); $3.60(fs), $1.31(mf) OTS
ORNL-TM–		
544	18-29623	Ind. Eng. Chem., Process Design Develop., 3: 266-70(1964)
811	18-30976	Dep.(mc); $3.60(fs), $1.13(mf) OTS
813	18-30955	Dep.(mc); $9.10(fs), $3.23(mf) OTS
868	18-30471	Dep.(mc); $3.60(fs), $1.19(mf) OTS
872	18-29605	Dep.(mc); $2.60(fs), $0.89(mf) OTS
ORNL-tr–		
77	18-30321	Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS
107	18-29850	Dep.(mc); $1.10(fs), $0.80(mf) JCL or OTS
179	18-30245	Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS
OTS–	**(Misc.)**	
64-31494	18-29867	See JPRS-25104
64-31520	18-30898	See JPRS-25168
PAN–	**(Polish)**	
301	18-30311	Dep.
486/II	18-30312	Dep.
492/VI	18-30517	Dep. Nukleonika, 9: 189-93(1964)
495/VII	18-30518	Dep.
501/VII	18-30893	Dep.
509/II	18-30174	Dep. Phys. Status Solidi, 5: K23-6(1964)
PPAD–		
509E	18-30801	Phys. Rev., 135: B289-93(1964)
PUC–		
1964-127	18-30814	Phys. Rev., 135: B389-401(1964)
R–	**(Misc.)**	
201	18-30888	See NP-14067
202	18-30403	See NP-14066
64SD-5	18-30482	$1.60(OTS)
RDR–	**(Non-AEC)**	
1325-4	18-30118	See RTD-TDR-63-4006(Pt.I)
1360-2	18-30105	See AD-429028
RFP–		
348	18-29983	Dep.; $0.50(OTS)
RM–	**(Misc.)**	
3932-PR	18-29823	$1.60(OTS) J. Geophys. Res., 69: 2861-6(1964)
RSIC–	**(Non-AEC)**	
151	18-30239	
RT-ING–	**(Italian)**	
(64)-4	18-30996	Dep.(mc)
RTD–	**(Non-AEC)**	
8-109(I)	18-30117	$10.10(OTS)
RTD-TDR–	**(Non-AEC)**	
63-3021	18-30313	$9.60(OTS)
63-4006(Pt.I)	18-30118	$21.00(OTS)
63-4110	18-29606	$2.60(OTS)
63-4147	18-29920	See IBM-63-521-21
SAN–		
409-1	18-29844	Dep.(mc); $2.60(fs), $1.10(mf) OTS
SAR-G–	**(French)**	
63-38	18-30734	Dep.(mc)
SC–	**(Misc.)**	
4452C(M)	18-31056	Dep.; $2.25(OTS)
SC-DC–		
64-764	18-31050	Dep.(mc); $2.60(fs), $0.83(mf) OTS
64-1034	18-29813	Dep.(mc); $1.60(fs), $0.80(mf) OTS
3157	18-30182	See TID-18550
SC-R–		
64-128	18-31051	Dep.(mc); $5.60(fs), $1.79(mf) OTS
64-145	18-29882	Dep.(mc); $1.60(fs), $0.80(mf) OTS
SC-RR–		
64-511	18-31021	Dep.; $2.75(OTS)
SIT–		
113	18-29958	Rev. Sci. Instr., 35: 801-2(1964)
114	18-30933	See CONF-471-22
SL–	**(Misc.)**	
1954	18-30997	Dep.(mc); $15.50(fs), $7.37(mf) OTS
SLAC-PUB–		
22	18-30059	Rev. Sci. Instr., 35: 881-5(1964)

Report No.	Abstract No.	Availability
32	18-30821	Phys. Rev. Letters, 13: 57-9(1964)
SRO–		
102	18-30998	Dep.(mc); $1.60(fs), $0.80(mf) OTS
SSD-TDR–	**(Non-AEC)**	
63-311	18-30673	$2.60(OTS)
SWRI–		
1228-21	18-30999	Dep.(mc); $2.60(fs), $0.83(mf) OTS
TDR–	**(Non-AEC)**	
169(3250-13) TR-1	18-30673	See SSD-TDR-63-311
TEI–		
848	18-31052	Dep.(mc); $2.60(fs), $0.83(mf) OTS
TID–		
3525(Rev.5, Suppl.1)	18-30950	Dep.; $1.75(OTS)
7028	18-30958	Dep.; $1.75(OTS)
7687	18-30483	Dep.; $5.00(OTS)
18550	18-30182	AIAA (Am. Inst. Aeron. Astronaut.) J., 2: 977-90(1964)
18817	18-29628	Inorg. Chem., 3: 1018-24(1964)
18818	18-29685	Nucl. Sci. Eng., 19: 296-9(1964)
18839	18-29169	Advan. Biol. Med. Phys., 9: 225-69(1963)
19520	18-30698	Nucl. Sci. Eng., 19: 343-52(1964)
20395	18-30586	Phys. Rev., 135: B459-66(1964)
20501	18-29984	Dep.(mc); $1.10(fs), $0.80(mf) OTS
20640	18-29567	Dep.(mc); $14.00(fs), $6.47(mf) OTS
20657	18-30735	Dep.(mc); $8.10(fs), $2.69(mf) OTS
20658	18-30736	Dep.(mc); $12.50(fs), $5.48(mf) OTS
20664	18-29845	Dep.(mc); $1.60(fs), $0.80(mf) OTS
20700	18-31001	Dep.(mc); $4.60(fs), $1.64(mf) OTS
20703	18-30074	Dep.(mc); $6.60(fs), $2.18(mf) OTS
20712	18-30519	Dep.(mc); $4.60(fs), $1.64(mf) OTS
20720	18-30520	Dep.(mc); $14.00(fs), $6.26(mf) OTS
20720(Paper 1)	18-30619	Phys. Rev., 135: B477-83(1964)
20720(Paper 4)	18-30522	Phys. Rev., 135: B1057-60(1964)
20726	18-30894	Dep.(mc); $1.60(fs), $0.80(mf) OTS
20728	18-29242	Dep.(mc); $1.10(fs), $0.80(mf) OTS
20735	18-30178	Dep.(mc); $3.60(fs), $1.19(mf) OTS
20750	18-30524	Dep.(mc); $3.60(fs), $1.28(mf) OTS
20751	18-30097	Dep.(mc); $1.60(fs), $0.80(mf) OTS
20755	18-30895	Dep.(mc); $1.60(fs), $0.80(mf) OTS
20760	18-30404	Dep.(mc); $2.60(fs), $0.98(mf) OTS
20761	18-29167	Dep.(mc); $1.60(fs), $0.80(mf) OTS
20764	18-31053	Dep.(mc); $1.60(fs), $0.80(mf) OTS
20767	18-31036	Dep.(mc); $4.60(fs), $1.46(mf) OTS
20768	18-29199	Dep.(mc); $1.60(fs), $0.80(mf) OTS
20769	18-30525	Dep.(mc); $1.60(fs), $0.80(mf) OTS Phys. Rev. Letters, 13: 66-9(1964)
20771	18-30526	Dep.(mc); $2.60(fs), $1.10(mf) OTS
20773	18-30527	Dep.(mc); $11.50(fs), $4.97(mf) OTS
20774	18-29243	Dep.(mc); $1.60(fs), $0.80(mf) OTS
20780	18-29244	Dep.(mc); $8.10(fs), $2.72(mf) OTS
20781	18-29192	Dep.(mc); $10.50(fs), $4.34(mf) OTS
20783	18-29245	Dep.(mc); $9.60(fs), $3.65(mf) OTS
20784	18-29246	$6.60(fs), $2.18(mf) OTS
20785	18-29247	Dep.(mc); $6.60(fs), $2.09(mf) OTS
20786	18-29248	$5.60(fs), $1.79(mf) OTS
20794	18-30098	Dep.(mc); $5.60(fs), $2.00(mf) OTS
20795	18-30099	Dep.(mc); $5.60(fs), $1.88(mf) OTS
20808	18-31000	Dep.(mc); $1.10(fs), $0.80(mf) OTS
20814	18-30528	Dep.(mc); $10.50(fs), $4.28(mf) OTS
20815	18-29249	Dep.(mc); $10.10(fs), $4.10(mf) OTS
20842	18-30595	Phys. Rev., 135: B551-60(1964)
TRECOM-TR–	**(Non-AEC)**	
63-73	18-30896	$2.60(OTS)
TT–	**(Canadian)**	
64-31617	18-30319	See JPRS-25344
UCD–		
472-110	18-29200	Dep.; $2.75(OTS)
UCOL–		
522	18-30376	Rev. Sci. Instr., 35: 902-3(1964)
UCRL–		
6146(Pt.I)	18-31022	Dep.(mc); $8.60(fs), $3.08(mf) OTS
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7370	18-29607	Dep.(mc); $3.60(fs), $1.16(mf) OTS
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7444	18-30100	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7449	18-30314	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7478-T	18-30737	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7659	18-30649	Dep.; $1.00(OTS)
7803	18-29866	Dep.; $0.75(OTS)
7829	18-29827	Dep.; $0.50(OTS)
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7877	18-31054	Dep.(mc); $1.60(fs), $0.80(mf) OTS
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